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ERRATA

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2	19	**45486** Nuclear reactor for breeding ^{233}U. Bohanan, C.S.; Jones, D.H.; Raab, H.F. Jr.; Radkowsky, A. (to Energy Research and Development Administration). US Patent 3,998,692. 21 Dec 1976. Filed date 8 Dec 1975. 6p.
3	7	**13622** (FE–1207-P25) BI-GAS pilot plant program. Interim report, July–September 1976. Hull, D.E. (Phillips Petroleum Co., Homer City, Pa. (USA)). Oct 1976. Contract EX-76-C-01-1207. 18p. Dep. NTIS, PC A04/MF A01.
3	10	**23208** (Y/OWI/SUB–77/42502) Generic description of radiological and meteorological monitoring program for federal repositories for radioactive wastes. (NUS Corp., Rockville, Md. (USA)). Sep 1977. Contract W-7405-ENG-26. 94p. Dep. NTIS, PC A05/MF A01.
3	20	**48515** (SAND–77-1623C) Full scale simulations of accidents on spent-nuclear-fuel shipping systems. Yoshimura, H.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 14p. (CONF-780506–41). Dep. NTIS, MF A01.
3	22	**52641** (BNL-NUREG–24483) Lumped-parameter modeling of one-dimensional two-phase flow. Wulff, W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 29p. (CONF-780659–1). Dep. NTIS, MF A01.
4	2	**2878** (CONF-7805138–1) Earth-covered residence concept for humid continental region. Chester, C.V.; Shapira, H.B.; Barnes, P.R.; Cristy, G.A. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 27p. Dep. NTIS, MF A01.
4	6	**12930** (DOE/NASA/CR–150581) Operations manual: on site monitor (OSM), solar heating and cooling systems. IBM Federal Systems Div., Huntsville, AL (USA)). 17 Oct 1977. Contract EX-76-A-29-1037. 17p. Dep. NTIS, PC A02/MF A01.
4	6	**13978** (CONF-771140–5) Influence of small amounts of niobium on mechanical and corrosion properties of type 304 stainless steel. Sikka, V.K.; Moorhead, A.J.; Brinkman, C.R. (Oak Ridge National Lab., TN (USA)). 1977. Contract W-7405-ENG-26. 44p. Dep. NTIS, PC A03/MF A01.
4	6	**14204** (FE–2018-10) Fundamentals of nitric oxide formation in fossil fuel combustion. Quarterly progress report for the period 11 September–10 December 1977. Houser, T. (Western Michigan Univ., Kalamazoo (USA)). Jun 1978. Contract EX-76-C-01-1570. 8p. Dep. NTIS, PC A02/MF A01. The quadrupole mass spectrometer was used to further examine the deuterium isotope effect on the rate of pyrolysis of pyridine. The results obtained at 900°C were inconsistent and believed unreliable, those at 1000°C showed an isotope effect that averaged 30 to 40%. Examination of product mixtures from the pyrolysis of C_5H_5N and C_5D_5N at about 53% reaction indicated that there may be a higher rate of ring fragmentation for the deuterated molecule, which would signify a shift in mechanism due to isotopic substitution.
4	6	**14625** (COO–2450-7(App.)) Iodine-129: a study of its transport in the environment and distribution in biological systems. Final progress report. Manuel, O.K. (Missouri Univ., Rolla (USA). Dept. of Chemistry). Jun 1978. Contract EY-76-S-02-2450. 9p. Dep. NTIS, PC A02/MF A01.
4	8	**18339** (LBL–8236) Petroleum plantations. Calvin, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 41p. (CONF-7804127–1). Dep. NTIS, PC A03/MF A01.
4	9	**24586** (LBL–8322) Role of neurotransmitters and protein synthesis in short- and long-term memory. Bennett, E.L.; Rosenzweig, M.R.; Flood, J.F. (California Univ., Berkeley (USA); California Univ., Los Angeles (USA). School of Medicine). Oct 1978. Contract W-74-5-ENG-48. 12p. (CONF-7808103–1). Dep. NTIS, PC A02/MF A01. From 2. world congress of biological psychiatry; Barcelona, Spain (30 Aug 1978).
4	10	**25257** (CONF-790205–4) Chemical development of new processes for the recovery of resource materials from coal ash. Seeley, F.G.; Canon, R.M.; McDowell, W.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 35p. Dep. NTIS PC A03/MF A01.

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(BAW—10074A(Rev.1))
Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.
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Volume 4, Number 17, September 15, 1979

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

PROCESSING

44198 Device for quenching coke. Hanley, J.F. Jr. (to Envirotech Corp., Menlo Park, CA (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,643,660/A/. 14 Apr 1977. 14p. (In German).

The invention represents a device for quenching coke, which prevents the exit of gaseous or particle emission. The coke comes from the coking oven through an ejection device into the quenching truck which is movable on rails by driving devices. The truck has a removable cover which is provided with a closing plate device, which largely covers the open side of the quenching truck and which forms small gaps (so called draft openings) with the ejection device, through which air is drawn through the opening in the cover, in order to draw off the emission from the coke which has reached the loading space in the quenching truck. Due to the relatively small draft openings, a very limited air flow is produced, which takes up the emission in the quenching truck and prevents escape of gaseous or particle emission around the cover. The air flow extracted is cleaned in a washing device before emission to the atmosphere.

CARBONIZATION

REFER ALSO TO CITATION(S) 44239

44199 Process for manufacturing calcinated coke. Farago, F.J.; Retallack, D.G.; Sood, R.R. (to Alcan Research and Development Ltd., Montreal, Quebec (Canada); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,654,971/A/. 16 Jun 1977. 31p. (In German).

The invention concerns the calcination of carbonaneous materials with a volatile material content up to 15%, e.g. petroleum coke and anthracite. Such materials are calcined in order to produce carbon for making electrodes and cladding for metallurgical processes. The calcination of particulate carbonaceous materials is carried out in rotating tube furnaces. Apart from the starting phase, at least 75% of the calcination heat is obtained from combustion of the volatile material released from the process material. For this purpose, combustion air is introduced at one or several positions in the furnace. The maximum temperature during calcination which determines the properties of the calcination product is maintained in an uncontrolled zone of the furnace situated above the first air inlet required for combustion air. In this zone, the calcination zone, the process material is whirled around by the volatile materials relased, which prevents a temperature measurement. The temperature in the uncontrolled zone is however controlled by determining nominal temperature values at a position below the uncontrolled zone and the gas temperature et the upper end of the rotating furnace, where both these temperatures represent the desired temperature of calcination and the desired position of the calcination zone. Deviations from the nominal value are counteracted by changing the following operating parameters: Speed of indtroducing combustion air, speed of rotation of furnace, speed of loading carbonaceous material.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 44204, 44225, 44227, 44229, 44230, 44246

44200 Hot gas cleanup. Morrison, G.F. London, England; IEA Coal Research (1979). 54p. (ICTIS/TR—03).

This review presents the current technological status of hot gas cleanup systems as applied to the cleaning of gases from coal gasifiers or fluidized bed combustors prior to their use in combined cycle power generating systems. The emphasis is on self-contained cleanup systems of general application which can be applied to various gasifiers or combustors. In-situ gas cleaning such as the removal of sulfur compounds by a sorbent within a fluidized bed combustor is not covered. Contaminants in the gas stream are identified as sulfur compounds, particulates, nitrogen compounds and trace elements. Hot gas desulfurization processes are classified according to the sorbent on which they are based; iron oxide or calcium. The section on particulate removal is subdivided according to the separation technique; cyclones, surface and depth filters, electrostatic precipitators and novel systems. References are given within the text to substantiate facts, to indicate further relevant published material and to give an indication of people and organizations with particular interests in specific fields of hot gas purification.

44201 Process for separating tar and solids from coal liquefaction products using a halogenated aliphatic solvent. Paraskos, J.A.; Smith, E.W. (to Gulf Research & Development Co.). US Patent 4,148,716. 10 Apr 1979. Filed date 21 Oct 1977. 12p.

A process for separating tar and solid particles from coal liquefaction products using a highly selective halogenated aliphatic solvent which removes essentially all of the tar and solid particles from the coal liquefaction products wherein a minimum amount of energy is used. This is accomplished by contacting said coal liquefaction products with the halogenated aliphatic solvent to form two phases, one containing said tar and solid particles and the other containing said solvent and the remainder of said coal liquefaction products.

44202 Reaction in a cascade of continuous stirred tank reactors of particles following the shrinking core model. Ruether, J.A. (Dept. of Energy, Pittsburgh, PA). *Can. J. Chem. Eng.;* **57**: No. 2, 242-245(Apr 1979).

The analysis has been developed specifically treating systems for the removal of sulfur from coal by selective oxidation in an aqueous slurry. This type of treatment is called chemical coal cleaning, and several processes are currently under development. Besides removing sulfur, some processes also reduce ash content and increase the fusion temperature of the remaining ash. An expected early use of chemically cleaned coal is in making oil slurries (COS) as an extender of fuel oil. The use of COS would involve minimal retrofit of existing oil fired burners. The so called chemical cleaning of coal is discussed briefly. 1 figure, 1 table.

44203 Method for improving the sedimentation and filterability of coal-derived liquids. Katz, S.; Rodgers, B.R. (to Dept. of Energy). US Patent 4,132,639. 2 Jan 1979. Filed date 4 Aug 1977. 10p. PAT-APPL-821,665.

An improvement in the separation of suspended solids from coal-derived liquids by a separations process in which solids size is a separations parameter is achieved by contacting the coal-derived liquid containing suspended solids with an effective amount of an additive selected from the group of sulfuric acid, phosphoric acid, phosphoric anhydride and salts of sulfuric and phosphoric acid, and maintaining the contacted liquid at a temperature within the range of about 150°-400° C and for a time sufficient to achieve the desired separation rate.

HYDROGENATION

44204 Steric effects in the hydrogenation—hydrodenitrogenation of isomeric benzoquinolines catalyzed by sulfided Ni—W/Al_2O_3.

Shabtai, J.; Veluswamy, L.; Oblad, A.G. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 1, 114-118(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Mechanistic aspects of sulfide-catalyzed hydrodenitrogenation of N-heterocyclics, and in particular of condensed polycyclic systems, have been studied to a limited extent. So far very little attention has been paid to the stereochemical aspects of hydrodenitrogenation processes. In order to obtain information on the possible importance of steric effects in such reactions, the hydrogenation—hydrodenitrogenation of two isomeric benzoquinolines, i.e., 5,6-benzoquinoline and 7,8-benzoquinoline, was comparatively studied as a function of reaction temperature, hydrogen pressure, and sulfided catalyst type. Experiments were carried out in a semi-batch reactor, and products formed were identified and analyzed by a combination of gas chromatography, PMR, and mass spectrometry.

GASIFICATION

REFER ALSO TO CITATION(S) 44240, 44247, 44248, 44249, 44252, 44262, 44274, 44458, 45403, 45404, 45405

44205 (AD-A—060475) **Gasification at navy bases. Final report.** McCone, A.I.; Ruby, J.D.; Mackewicz, W.V.; Miller, T.D.; Buder, M.K. (Bechtel National, Inc., San Francisco, CA (USA)). Jul 1978. Contract N68305-77-C-0021. 117p. NTIS PC A06/MF A01.

Coal gasification is recognized as a way to produce a clean burning boiler fuel from coal within acceptable environmental limits. The study was to assist the Navy in determining how coal might best be utilized, by comparing gasification with central direct coal-fired boiler systems at each of five bases. Bechtel showed in a previous study for CEL that gasification plants could be economically attractive at Navy bases. Gas from a plant producing 250 x 1,000,000 Btu/hr with a load factor of 90 percent was shown to have a lower life cycle cost than continued use of fuel oil. This second study examined plants as they would actually be operated. A conceptual design study comparing coal gasification with central direct coal-fired boilers at five bases was performed.

44206 (DOE/ET—0067/1) **Coal gasification. Quarterly report, January—March 1978.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Sep 1978. Contract EX-76-C-01-2297. 72p. Dep. NTIS, PC A04/MF A01.

Some 17 coal gasification projects supported by U.S. DOE are reviewed briefly (operating company, plant sites, contract number, funding, process description, flowsheets, history and progress in the current quarter.) (LTN)

44207 (DOE/ET—0067/2) **Coal gasification. Quarterly report, April—June 1978.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jan 1979. Contract EX-76-C-01-2297. 66p. Dep. NTIS, PC A04/MF A01.

Although the basic coal-gasification chemical reactions are the same for all high Btu gasification processes each of the processes under development has unique characteristics. There are, for example, important differences in reactor configurations and methods of supplying heat for gasification. Moreover, because these processes require high temperatures and some require high pressures, temperature-resistant alloys and new pressure vessels must be developed to obtain reliable performance. A number of the processes for converting coal to high-Btu gas have reached the pilot plant stage. Laboratory research is also continuing in order to develop data for verifying the feasibility of the specific process and for supporting the operation of the plant. Responsibility for designing, constructing, and operating these pilot plants is identified and quarterly progress is discussed briefly for each process. Low-BTU gas, with a heating value of up to 350 Btu per standard cubic foot, is an economical fuel for industrial use as well as for power generation in combined gas-steam turbine power cycles. On an equivalent Btu basis, conversion of coal to low-btu gas is less complex than conversion to high-Btu, and the associated capital costs are lower. Because different low-Btu gasification processes are optimum for converting different types of coal, and because of the need to provide commercially acceptable processes at the earliest possible date, DOE is sponsoring the concurrent development of several basic types of gasifiers (fixed-bed,fluidized-bed, and entrained-flow). At the same time, the subject of hot-gas cleanup is being studied for use with these low-Btu gasifier systems. Several other projects (combined-cycle power plants using low Btu gas, test facilities, mathematical models and a coal conversion technical data book complete the DOE gasification program. (LTN)

44208 (FE—1793-43) **Coal feeder development. Phases II and III. Progress report, January 1—June 30, 1978.** (Foster-Miller Associates, Inc., Waltham, MA (USA)). Oct 1978. Contract EX-76-C-01-1793. 31p. Dep. NTIS, PC A03/MF A01.

Program effort was directed to continued development of the FMA Linear Pocket and Centrifugal coal feeders and the development of an enlarged batch test loop (one hour run time at 5 tons per hour) to test the feeders. The FMA Linear Pocket Feeder (LPF) met or exceeded all Phase II performance goals. The feeder repeatedly fed coal at 5 tons per hour against a 500 psig back pressure with negligible leakage. The technical feasibility of this concept has been established. Continued development of the LPF under Phase III of the feeder contract has been recommended and approved. Testing of the 200 psi Centrifugal Feeder prototype revealed that the prototype feeder power requirements can be reduced by 45 to 55 percent by incorporating the feeder discharge hoppers into the rotor and streamlining the rotor. Design of the 500 psig Centrifugal Feeder prototype is about 85 percent completed. Design of the enlarged test facility has been completed and erection of the facility is about 20 percent complete.

44209 (FE—2032-8) **Sulfur resistant methanation catalysts. Annual report, July 1, 1976—June 30, 1977.** Hausberger, A.L.; Kustes, W.A. (Catalysts and Chemicals, Inc., Louisville, KY (USA)). 13 Sep 1977. Contract EX-76-C-01-2032. 33p. Dep. NTIS, PC A03/MF A01.

Fifty-two activity tests have been completed on forty-five different catalyst compositions which were studied as sulfur-resistant methanation catalysts. A maximum conversion of carbon monoxide to methane of 84% was achieved at one point with nickel and chromium on magnesium silicate. This catalyst also demonstrated a reproducible conversion of 67% with very low steam and 3 to 10 ppM hydrogen sulfide in the feed gas. Tests during the past year have mainly involved catalysts which contain support material other than alumina. In order to screen the catalysts as quickly as possible, extensive test condition variations were not performed, with the exception of a steam to gas variation study during one test. Several series of catalyst variations were prepared and tested, but most were found to be inactive. Significant methanation of 60 to 70% of the carbon monoxide has been achieved only with nickel and chromium on magnesium silicate and on magnesium aluminate.

44210 (FE—2247-18) **Gasification of residual materials from coal liquefaction. Annual report,, July 1977—June 1978.** Robin, A.M. (Texaco, Inc., Montebello, CA (USA). Montebello Research Lab.). Sep 1978. Contract EX-76-C-01-2247. 28p. Dep. NTIS, PC A03/MF A01.

Type I Laboratory Evaluations have been completed with samples of residue from four coal liquefaction processes. Two of the residues may be fed to a Texaco gasifier as a molten fluid while the remaining two residues must be slurried in water or some other suitable carrier fluid. Three out of the four residues were judged to be suitable feedstocks, while one residue was judged to be only marginal. These residues are listed. Type II preliminary pilot plant evaluations have been completed at 350 psig with 20 bbls of residue from each of two coal liquefaction processes. These residues are also listed. While both pilot plant runs confirmed operability and predicted performance, the viscosity of the Exxon residue was too high for optimum operation of the pilot plant equipment. However, higher temperatures attainable in a commercial plant should eliminate this problem. The residues which were evaluated last year are listed for reference. All ERDA/DOE reports published to date on this project are listed.

44211 (FE—2276-24) **Development studies on selected conversion of synthesis gas from coal to high octane gasoline. Quarterly report, April—June 1978.** Brennan, J.A. (Mobil Research and Development Corp., Paulsboro, NJ (USA)). Jul 1978. Contract EX-76-C-01-2276. 36p. Dep. NTIS, PC A03/MF A01.

Mild oxidative regeneration studies with developmental catalyst SG-B-3 have continued in the micro reactor units. The best regeneration scheme thus far identified maintains a constant aging rate through six cycles. However, start of cycle activity falls dramatically at the tenth cycle. A regeneration procedure has been found for catalysts SG-A-4 and SG-A-5 in the micro reactor units and for SGF-A-3 in the fluid, bench-scale unit. Flow studies have been completed with catalyst SGF-A-4 in the plexiglass model of the bench-scale, fluid unit.

44212 (FE—2361-19) **Development of a fast fluid bed gasifier. Phase I, Task II. Quarterly progress report, July—September 1977.** Molayem, B.; Koziel, M. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Oct 1977. Contract EX-76-C-01-2361. 39p. Dep. NTIS, PC A03/MF A01.

The objective of the overall program is to develop a coal gasifier for low Btu gas utilizing the principle of the fast fluid bed unit operation. The objective of the work is to determine operating parameters, feasibility and viability of a fast fluid bed gasifier. Task II of the program, the construction of the experimental gasifier system, continued.

44213 (FE—2416-33) **Conceptual designs of commercial facilities coal-to-methanol plant and methanol-to-gasoline plant. Annual report for August 1, 1977—July 28, 1978.** (Badger Plants, Inc., Cambridge, MA (USA)). 12 Sep 1978. Contract EX-76-C-01-2416. 35p. Dep. NTIS, PC A03/MF A01.

Quarterly report, 1 May 1978—28 July 1978 included.

The conceptual design of a methanol-to-gasoline commercial plant is based on available data derived from the joint DOE/Mobil project contract No. E(49-18)-1773. Mobil agreed to review Badger's effort in a consulting and advisory role. The coal-to-methanol plant is estimated to cost $3.1 billion dollars (1977) and is designed to produce 415,000 barrels of methanol products per scheduled day. On the assumption that the plant had been operable in 1977 and based upon the parameters listed, the 1977 cost for methanol fuel would be 18.8 cents per gallon, equivalent to $3.00 per million Btu.

44214 (FE—2729-4) **Alloy catalysts with monolith supports for methanation of coal-derived gases. Annual technical progress repot, September 20, 1977—September 20, 1978.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). Oct 1978. Contract EF-77-S-01-2729. 67p. Dep. NTIS, PC A04/MF A01.

The activity, selectivity and stability of alumina-supported nickel and nickel bimetallics in methanation of CO has been investigated. Support geometry, in situ H_2S poisoning tests, and carbon deposition tests have continued. Support geometry studies show that, at high conversions and high through-put conditions, monolithic supported catalysts are more active than pellet supported catalysts. In situ H_2S poisoning studies show that the Ni—MoO_3 is more active and sulfur resistant than Ni and that H_2S does not completely deactivate the surface under reaction conditions. In carbon deposition tests Ni—Pt and Ni—Co maintain catalytic activity longer than Ni. In H_2S poisoning studies a synergistic effect is noted for Ni—Co compared to Ni and Co catalysts. The Ni—Co catalyst retains more activity than either Ni or Co after H_2S/H_2 poisoning. Recent CO chemisorption experiments at various temperatures show that nickel carbonyl formation is significant at room temperature, and that CO uptakes depend greatly on the chemisorption temperature. Upper operating temperature limit tests showed that catalysts prepared in this laboratory are more active than commercial catalysts and that carbon deposition is not the only factor causing deactivation at high temperatures. These and other significant results are presented and discussed.

44215 (METC/CR—79/23) **Sour water stripping of coal gasification waste water.** Verhoff, F.H.; Choi, M.K. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). May 1979. 108p. Dep. NTIS, PC A06/MF A01.

This vapor—liquid equilibrium model for carbon dioxide—ammonia—water—hydrogen sulfide—organics and all the ionic species was used for the preliminary design of the stripping column. A simple design procedure was selected and used to investigate the influence of various parameters on the process. These parameters include steam to sour water flow ratios, the number of theoretical plates, and various other parameters. There are two basic conclusions to the study. First, a significant fraction of the organics (in the range of 50%) will be removed in the steam. This organic loss in the steam severely limits the utility of the stripping column. There are two possible means of over-coming this difficulty; a distillation column could be installed instead of the stripping column or valuable compounds could be recovered from the steam. Only the latter alternative has any chance for economic viability. The second important conclusion is that in any process for the removal of ammonia and hydrogen sulfide, the sour water should first be passed through a flash drum to remove the majority of the carbon dioxide before entering the stripping column. The various unexpected problems encountered as the work developed are discussed in detail. (LTN)

44216 (PB—286659) **Guidelines for preparing environmental test plans for coal gasification plants. Final report, May 1976-December 1977.** Page, G.C.; Corbett, W.E.; Thomas, W.C. (Radian Corp., Austin, TX (USA)). Jul 1978. Contract EPA-68-02-2147. 187p. NTIS PC A09/MF A01.

The report outlines a philosophy and strategy for preparing environmental assessment sampling and analysis (test) plans. Five major points of test plan development are addressed: (1) defining the test objectives, (2) performing an engineering analysis of the test site, (3) developing a sampling strategy, (4) selecting analytical methods, and (5) defining data management procedures. The important considerations involved in each area are discussed in relation to three types of environmental tests: (1) waste stream (Levels 1, 2, and 3), (2) control equipment, and (3) process stream characterization. Specific sampling and analytical methods are presented, with numerous references cited for more detailed information.

44217 (SAN—1254-2) **Modeling of coal gasification for fuel cell utilization. Final report, May 1, 1976—June 6, 1978.** Finson, M.L.; Kothandaraman, G.; Lewis, P.F.; Simons, G.A.; Wilemski, G.; Wray, K.L. (Physical Sciences, Inc., Woburn, MA (USA)). Jun 1978. Contract EY-76-C-03-1254. 158p. (PSI-TR—136). Dep. NTIS, PC A08/MF A01.

This report summarizes recent progress on a DOE-supported program to construct computer models for potential future combined coal gasification/fuel cell power generation systems. The approach is to develop physically well-founded descriptions for the performance of both molten carbonate fuel cells and coal gasifiers, and to utilize the models to prepare performance maps for each device, enabling selection of the optimum interfaces between fuel cells and gasifiers. In a previous phase of the study, we identified entrained flow gasification as the most appropriate type for providing fuel cell feed gas, on the basis of off-gas composition and the ability to handle a wide range of coal types. Accordingly, a substantial portion of the current effort is concerned with the development of a computer model for entrained flow gasifiers. Furthermore, several scaling laws have been developed for fuel cell performance. Mostly based on equilibrium (open-circuit) considerations to date, these address such issues as the requirements for avoiding carbon deposition, the potential effects of methane conversion, and the distribution of heat sources and sinks within the cell.

44218 (UCRL—82459) **Costs of drilling, completing and linking process wells for underground coal gasification as a function of linking method, coal bed thickness and depth.** Stephens, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Apr 1979. Contract W-7405-ENG-48. 17p. (CONF-790630—1). Dep. NTIS, PC A02/MF A01.

From 5. underground coal conversion symposium; Alexandria, VA, USA (18 Jun 1979).

Costs in underground coal gasification for drilling, completing and linking process wells are considered. Both row spacing (sweep width) and column spacing for rectangular arrays of process wells were examined: coal bed thickness and depth were varied; linking methods were estimated which included reverse combustion, directional drilling using the Dyna-drill and a hypothetical tool capable of drilling horizontal channels from a process well (right-angle drill), and shaped-charge assisted reverse combustion. The cost penalty for a linking method which causes override of the coal seam in UCG was estimated to be 0.75 $/10^6$ Btu using the Hoe Creek No. 2 gas composition. For reasonable coal thickness and depths, such as 30′ thickness and 500′ depth, 0.75 $/10^6$ Btu is much larger than the differences in linking cost, and reliable but more expensive linking methods may be more cost-effective. However, considering the drilling and linking costs only, reverse combustion appears to be the lower cost linking option at depths less than 500′, while at greater depths, the directional drilling methods, in particular the hypothetical right-angle drilling method may offer potential cost advantages.

44219 (UCRL—82541) **Reverse combustion along a borehole in a shrinking coal preliminary results.** Aiman, W.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Mar 1979. Contract W-7405-ENG-48. 14p. (CONF-790405—18). Dep. NTIS, PC A02/MF A01.

From AICE meeting; Houston, TX, USA (1 Apr 1979).

Reverse combustion along a bored hole (76 mm diameter) will be used during Lawrence Livermore Laboratory's next field experiment in underground coal gasification: Hoe Creek III. The enlarged channel produced by the reverse combustion will allow high gas velocities for the forward combustion phase of gasification. In the present experiments, reverse combustion along smaller boreholes (6.35 and 12.7 mm diameter) was investigated in coal blocks which were 0.5 m in diameter and 0.9 m long. In these experiments reverse combustion did not propagate with air as the feed gas. Three air velocities (14, 27, and 32 m/s) were tried in the 6.35 mm borehole and two velocities (7.5 and 21 m/s) were tried in the 12.7 mm borehole. All experiments were conducted at atmospheric pressure. Reverse combustion did propagate when the feed gas oxygen content was increased to 32%. Rates up to 14 m/day were found with an inlet gas velocity of 27 m/s. Product gas compositions are reported and discussed.

44220 **Valve for controlling solids flow.** Feldman, D.K. (to Dept. of Energy). US Patent Application 927,806. 25 Jul 1978. 11p.

A fluidized solids control valve is disclosed that is particularly well adapted for use with a flow of coal or char that includes both large particles and fines. The particles may or may not be fluidized at various times during the operation. The valve includes a tubular body that terminates in a valve seat covered by a normally closed closure plate. The valve body at the seat and the closure plate is provided with aligned longitudinal slots that receive a pivotally supported key plate. The key plate is positionable by an operator in inserted, intermediate and retracted positions respecting the longitudinal slot in the valve body. The key plate normally closes the slot within the closure plate but is shaped and aligned obliquely to the longitudinal slot within the valve body to provide progressively increasing slot openings between the inserted and retracted positions. Transfer members are provided between the operator, key plate and closure plate to move the closure plate into an open position only

when the key plate is retracted from the longitudinal slot within the valve body.

44221 Corrosion in reducing atmospheres: a designer's approach. Probert, P.B.; Katz, L. (Babcock & Wilcox Co., Barberton, OH). pp 205-213 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The design of equipment for service in reducing atmospheres containing H_2S requires careful attention to metal temperatures. The effects of gas temperature and steam pressure on corrosion were studied for carbon steel and stainless steel for a typical coal gasifier. Areas of acceptable corrosion life and thermal stress were identified.

LIQUEFACTION

REFER ALSO TO CITATION(S) 44201, 44210, 44211, 44220, 44240, 44248, 44249, 44252, 44458

44222 (DOE/ET—0068/2) **Coal liquefaction. Quarterly report, April—June 1978.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jan 1979. Contract EX-76-C-01-2297. 56p. Dep. NTIS, PC A04/MF A01.

Current DOE program work is aimed at improved process configurations for both catalytic and non-catalytic coal liquefaction rpocesses to provide more attractive processing economics and lower capital investment. The advantage of coal liquefaction is that the entire range of liquid products, especially heavy boiler fuel, distillate fuel oil, and gasoline, can be produced from coal by varying the type of process and operating conditions used in the process. Furthermore, coal-derived liquids have the potential for use as chemical feedstocks. DOE is supporting the development of several conversion processes that are currently in the pilot plant stage. Responsibility for designing, constructing and operating these pilot plants is identified and quarterly progress of each is discussed briefly. Also included in the coal liquefaction program are support research and development activities that provide backup for advanced liquefaction processes and improvements in liquefaction technology in general. Indirect liquefaction (liquid fuels via syngas from coal) is under active evaluation. Laboratory efforts have been encouraging in developing an efficient two-stage process and an improved disposable catalyst. Several of these projects are discussed briefly. Finally, efforts in upgrading coal liquids and in utilizing coal liquefaction residues by fluid coking or gasification are described. (LTN)

44223 Catalysis of coal liquefaction processing. Combustion of coal and synthetic fuels. General papers. Undergraduate and graduate education in fuel science and engineering. Washington, DC; American Chemical Society (1978). 330p. (CONF-780305—P6). Univ. Microfilms, 300 N. Zeeb Rd., Ann Arbor, MI $8.00.

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The American Chemical Society, Division of Fuel Chemistry, meeting was held at Anaheim, California, March 12-17, 1978. Preprints of papers presented have been published as volume 23, No. 1. The papers involve catalysis of coal liquefaction processing, combustion of coal and synthetic fuels, general papers, and undergraduate and graduate education in fuel science and engineering. Twenty-seven papers have been entered individually into EDB and ERA; one had been entered previously from another source. (LTN)

44224 (FE—1743-62) **Zinc halide hydrocracking process for distillate fuels from coal.** Greene, C.R.; Zielke, C.W.; Pell, M.; Bagshaw, G.H.; Struck, R.T. (Conoco Coal Development Co., Library, PA (USA). Research Div.). 20 Nov 1978. Contract EX-76-C-01-1743. 67p. Dep. NTIS, PC A04/MF A01.

Break-in of the Liquefaction Section of the 1 TPD Process Development Unit was completed, and runs feeding Ft. Lewis solvent refined coal were made (SRC-I). The expected high conversions and high yields of gasoline were obtained even at the lower pressure of 17.3 MPa (2500 psig). Many equipment revisions are still being made to correct problems encountered and to upgrade the system reliability. No fundamental process or equipment problems have been encountered. The final run with SRC before turning to break-in of the Regeneration Section will add continuous fractionation of the product with recycle of all +200°C oil until steady-state is achieved. An economic comparison of gasoline costs feeding SRC versus feeding coal directly is nearly complete. Direct coal feeding would be more economical. A corrosion study of refractories and metal alloys under condensing zinc chloride (oxychlorination) conditions is reported.

44225 (FE—2270-36) **Solvent refined coal (SRC) process operation of solvent refined coal pilot plant. Quarterly technical progress report for April—June 1978.** Lewis, H.E.; Weber, W.H.; Usnick, G.B.; Hollenack, W.R.; Blair, H.O.; Boykin, R.G. (Catalytic, Inc., Wilsonville, AL (USA)). Jan 1979. Contract EX-76-C-01-2270. 149p. Dep. NTIS, PC A07/MF A01.

Operating conditions and test results obtained at the Solvent Refined Coal (SRC) pilot plant in Wilsonville, Alabama during the second quarter of 1978 are summarized. Indiana V coal was processed throughout the second quarter. A study of the effects on SRC yield of hydrogen partial pressures ranging from 700 to 1,400 psia was completed. The effects of changing solvent quality were also investigated. Operation of the Kerr—McGee Critical Solvent Deashing (CSD) Unit was begun. SRC containing 0.03 to 0.15% ash was produced at feed rates up to 300 lb/hr. Other mineral residue separation experiments included pressure-leaf filtration using low-cost, readily available filter aids and solid-bowl centrifugation with the addition of an antisolvent to the feed.

44226 (FE—2306-15) **Research and development of an advanced process for the conversion of coal to synthetic gasoline and other distillate fuels. Quarterly technical progress report No. 5, May 1977—July 1977.** Schneider, A.; Hollstein, E.J.; Janoski, E.J.; Talbot, A.F. (Suntech, Inc., Marcus Hook, PA (USA). Research and Engineering Div.). Aug 1977. Contract EX-76-C-01-2306. 45p. Dep. NTIS, PC A03/MF A01.

We conclude from our present work that: (1) reaction times of one to two hours at 425°C, 2500 PSIG in the presence of hydrogenated anthracene oil and 10 wt. % catalyst are sufficient to convert about 90 wt. % MAF coal to gases and liquids; (2) hydrogen consumption under these conditions is about 12 to 18 MSCF H_2 per ton of MAF coal; 11 to 17 MSCF H_2 per ton of dry coal - an estimated 3 to 5 MSCF H_2 per barrel of product; (3) under these reaction conditions, about 80 to 85 wt. % of the coal-derived liquids which are produced are distillable below 1000°F; (4) the heavy gas oil fraction of these coal-derived liquids contains relatively large amounts of nitrogen and three and four-ring aromatics. It is, therefore, a poor catalytic cracking stock and will require additional processing to convert it to an acceptable petroleum refinery feed; (5) in the hydrogenation of coal in a solvent at 400°C, the Filtrol HPC-5 catalyst appears to be superior to the Sun CoMo on bauxite catalyst in terms of oxygen and nitrogen removal and hydrogenation ability; (6) the single ebullating bed reactor, a la HRI, is preferable to our previous design (a stirred tank coupled to a bank of three ebullating bed reactors) for the BSCU we plan to construct and operate; and (7) treatment with hydrogen chloride of the 1000°F⁻ distillate fraction of the filtered liquid products of coal-solvent hydrogenations produced under these reaction conditions does not result in a precipitation of nitrogenous material.

44227 (FE—2315-31) **Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Quarterly report, July—September 1978.** Sullivan, R.F. (Chevron Research Co., Richmond, CA (USA)). Oct 1978. Contract EX-76-C-01-2315. 48p. Dep. NTIS, PC A03/MF A01.

Pilot plant tests on the hydrotreating of SRC-II process product indicate that this coal-derived feed is a suitable feed for refining using advanced commercial petroleum processing technology. Experiments are in progress to evaluate several different combinations of refinery processes for conversion of SRC-II to transportation fuels. Nitrogen in the whole SRC-II process product can be reduced to a concentration of less than 0.5 ppM in a single catalytic stage. Sulfur and oxygen can also be reduced to low lvels; and at high severity, most of the aromatic compounds are converted to naphthenes. The naphtha appears to be an excellent catalytic reformer feed, and the middle distillate meets the smoke point specification for jet fuel. As the processing severity is decreased, product nitrogen increases; and the product becomes more aromatic.

44228 (FE—2547-26) **Laboratory program to support H-Coal Pilot Plant operations. PDU Run 6: syncrude mode operating using Wyodak coal.** Comolli, A.G.; Johanson, E.S.; Sheth, P. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Nov 1978. Contract EF-77-C-01-2547. 122p. Dep. NTIS, PC A06/MF A01.

PDU 6 was a thirty-day run in the H-Coal syncrude mode using Wyodak coal. It simulated the planned operating conditions for Run 3 of the H-Coal Pilot Plant Technical Management Plant. The major achievements and observations from this milestone run are summarized. This is the first PDU operation in which Wyodak coal was successfully processed in a balanced syncrude mode with an equilibrated catalyst bed as in the Pilot Plant. Coal conversion was higher than Pilot Plant design, from 91 to 93.5% of MAF coal feed and the C_4-975°F distillate yield equilibrated at 45 W % of dry coal in operations with a catalyst replacement rate of 1.1 lbs/ton of coal. A yield of 50% C_4-975°F distillate was obtained in early operations of the run. The equilibrated distillate yield level was about 2 W % below the Pilot Plant design basis with gas yield 3% higher. After the 30-day run, the catalyst was removed in a free flowing condition with no agglomeration or evidence of calcium induced deposits.

44229 (FE—2550-6) **Physical and chemical behavior of liquefied coal in solids separation. Quarterly report, January—March 1978.** Briggs, D.E.; Addington, D.V.; Cameron, J.R.; McKeen, J.A.; Smith, P.A.S.; Brack, R.L.; Ho, B.; Romine, J.C. (Michigan Univ., Ann Arbor (USA)). Apr 1978. Contract EX-76-S-01-2550. 47p. Dep. NTIS, PC A03/MF A01.

Procedures were developed to examine the acidic and basic portions of asphaltenes. The bases in the larger molecular weight asphaltene fractions isolated by GPC were found to contain approximately 2.5 basic nitrogen atoms per molecule while the lower molecular weight fractions had values closer to 1. A procedure for determining the phenolic content of the acid fraction was developed. Vacuum distillation of an asphaltene sample from 100 to 300°C produced highly aliphatic products. The residue became a brittle, glass material. Additional filter cake compressibility data were taken at 232°C (450°C) and found to be in agreement with previous data. The compressibility factor was found to be 0.8. The effect of asphaltene concentration on the specific cake resistance was found to be less at 232°C(450°C) than at 177°C (350°F) when slurries of asphaltenes, tetralin and THF insoluble solids were filtered. The specific cake resistance of pyridine-insoluble solids was higher than for THF insoluble solids over a temperature range of 121 to 232°C. Initial work on viscosity reduction was begun. A study of the solubility characteristics of model compounds was begun. Zeta potentials were determined from streaming potential data previously reported. Hydrogen bonding aspects of asphaltene adsorption were reviewed. Plans were made to modify a Weissenberg rheogoniometer for rheological determination of coal derived liquids. Miniature pressure transducers were ordered. Procedures were evaluated for material preparation for the rheological studies and melting points determined for a number of samples.

44230 (FE—2550-7) **Physical and chemical behavior of liquefied coal in solids separation. Quarterly report for period ending June 30, 1978.** Briggs, D.E.; Brack, R.; Ho, B. (Michigan Univ., Ann Arbor (USA)). Jul 1978. Contract EX-76-S-01-2550. 62p. Dep. NTIS, PC A04/MF A01.

Work on asphaltene acid derivatives revealed that the equivalent weights of the derivatives from GPC fractions varied but from 688 to 1010 compared to a variation of over three in molecular weights. The specific cake resistance of filter cake from the filtration of product oil slurries from the H-Coal process increased by a factor of 8 as the temperature was increased from 121 to 232°C. Addition of 20 wt. % tetralin or toluene reduces the cake resistance to ~ 1/2 at temperatures above 180°C. Solubility studies with toluene insoluble residue indicate that the solubility of the residue in pyridine increases as the concentration of the residue increases indicating a self-solubilization character in the material. As little as 1% addition of asphaltenes to benzene, toluene, or tetralin increases the electrical conductivity of the solvents by two orders of magnitude. The dielectric constant also increases but only by about 20%. Electric deposition of asphaltenes from solution is most significantly influenced by the hydrogen bonding characterisitcs of the solvent. Deposition on both electrodes show considerable enrichment of metals. Vacuum still bottoms from the H-Coal process exhibits non-Newtonian behavior, but individual oil and resin, asphaltene and preasphaltene fractions isolated from the residue do not in the temperature ranges studied.

44231 (LBL—9108) **Fischer—Tropsch synthesis over a ruthenium catalyst: infrared and kinetic studies.** Ekerdt, J.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemical Engineering). Apr 1979. Contract W-7405-ENG-48. 117p. Dep. NTIS, PC A06/MF A01.

Thesis.

The synthesis of hydrocarbons from CO and H_2 was studied on a silica-supported Ru catalyst and the species present on the catalyst surface were characterized by infrared spectroscopy. The synthesis of ethane, propylene, and propane, the principle products observed in addition to methane, were favored at high CO partial pressures, low H_2/CO ratios, and low temperatures. Evidence obtained from the combined infrared and kinetic studies suggests that the first stage of reaction involves the dissociation of CO to produce surface carbon atoms. Hydrogenation of the surface carbon to ethane and propane in the absence of chemisorbed CO suggests that chain propagation does not involve CO insertion into a metal-alkyl type intermediate. In an attempt to identify reaction intermediates, ethylene and cyclohexene were added to the synthesis gas feed. In the case of ethylene enhanced yields of propylene were observed. When cyclohexene was used as a scavenger, a series of alkyl cyclohexene and alkyl cyclohexane products were obtained. The results of both experiments suggest that alkylidene groups are present on the catalyst surface. Reaction mechanisms for the formation of methane are developed and used to formulate methanation rate expressions consistent with the experimental observations. In addition, reaction mechanisms for the formation of higher molecular weight olefins and alkanes are proposed which incorporate the postulated alkylidenes in chain growth as well as chain termination steps.

44232 **Hydroliquefaction of sub-bituminous and lignitic coals to heavy pitch.** Sze, M.C. (to Lummus Co.). US Patent 4,148,709. 10 Apr 1979. Filed date 27 Oct 1977. 6p.

In the hydroliquefaction of a sub-bituminous and/or lignitic coal, the inlet temperature to the hydroliquefaction zone is maintained at a temperature higher than those previously employed by providing recycle of hot liquid from the outlet portion of the hydroliquefaction zone. In this manner, the hydroliquefaction is operated at higher average temperatures, and total reaction volume is reduced, thereby reducing overall costs.

44233 **Coal-derived asphaltenes. Relationship between chemical character and process history.** Bockrath, B.C.; Noceti, R.P. (Dept. of Energy, Pittsburgh, PA). *Fuel Process. Technol.;* **2**: No. 2, 143-153(Mar 1979).

The chemical character of asphaltenes isolated from coal-derived liquids and the relative ease of their catalytic and noncatalytic conversion to oil has been found to depend upon their processing history. To facilitate chemical characterization, a simple analytical method was developed for separation of the asphaltenes into three subfractions according to their relative strength of absorption on silica gel. Using this separation technique, differences in the relative content of polar molecules were found among asphaltenes of various processing histories. In general, the relative content of polar compounds in the asphaltenes decreases with increasing conversion to oil. The relative rate of conversion also declines after the asphaltene content reaches a low level. The asphaltenes remaining after long hydrotreatment are more aromatic, contain fewer polar functional groups and are of somewhat smaller molecular size than those obtained after short hydrotreatment. The initial rates of asphaltene conversion were considerably enhanced by a commerical CoMo hydrodesulfurization catalyst. The catalyst increased the conversion of the nonpolar subfraction to a greater extent than the polar subfraction.

44234 **Hydrogen consumption in non-catalyzed coal liquefaction.** Thomas, M.G.; Granoff, B.; Noles, G.T.; Baca, P.M. (Sandia Labs., Albuquerque, NM). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 1, 42-49(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The discussion has considered liquefaction as two competing reactions; one which produces solubilized defunctionalized products, and a pyrolysis reaction which consumes hydrogen. Responses of the reactions to the independent variables of pressure, temperature, and time have been described and suggest that hydrogen pressure and time favor the liquefaction reactions (decreases in C/H ratio, decreases in sulfur, and increases in conversion), but that temperature seems to preferentially favor pyrolysis. These conclusions are in general agreement with literature data. Additionally it has been shown that: (1) sulfur removal occurs concurrent with conversions among the various solvent extraction fractions, (2) conversion varies with H_2 consumption among a number of similar but different coals, and (3) hydrogen consumption must be evaluated on the basis of a total balance, not just a change in concentration of H_2 gas.

44235 **Concept and use of hydrogen permeable catalysts.** Karr, C. Jr.; McCaskill, K.B. (Morgantown Energy Research Center, WV). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 1, 50-61(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The successful implementation of the concept of hydrogen permeable catalysts to coal-derived gases or liquids, and even coal or coal/recycle oil slurries, may offer several technical and economic advantages. These could include the virtual absence of unused hydrogen that has to be purified, recompressed and recycled at considerable expense, because essentially all the hydrogen could be consumed at the catalyst surface, without forming hydrogen bubbles. Another advantage, as suggested by Rudd's work, is that the catalyst surface could be kept free of carbon deposits because, just as oxides were removed by reaction with hydrogen diffusing up through the metal, so coking precursors would be converted by hydrogenation, preventing the formation of carbonaceous deposits. Finally, it may be possible to prevent the buildup of mineral deposits when coal or coal slurries are used, because the presence of a monomolecular or monoatomic layer of hydrogen at the surface would prevent the adhesive forces between the mineral particles and the catalyst surface from being effective. Experiments to test this concept are reported.

44236 **Nature of metals in petroleum fuels and coal-derived synfuels.** Filby, R.H.; Shah, K.R.; Yaghmaie, F. (Washington State Univ., Pullman). pp 51-64 of Ash deposits and corrosion due to

impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Petroleum is a complex mixture consisting mainly of aliphatic, alicyclic and aromatic hydrocarbons but also containing variable amounts of metal containing compounds including metalloporphyrins. Nickel and vanadium are normally the most abundant metals in petroleum with Ni ranging from 0.001 to 500 μg/g and V ranging from 0.01 to 1500 μg/g in crude oils. Both Ni and V are distributed in porphyrin (Ni and V) and nonporphyrin forms. The nature of the nonporphyrin Ni and V is poorly defined but is associated with the high molecular weight asphaltene sheet structure. Trace elements, other than Ni and V, are present in oils at much lower concentrations and appear to be associated only with the high asphaltene/resin fraction of the oil. The trace element contents of shale oil and coal-derived Solvent Refined Coal are lower than the parent oil shale and coal but (except for Ni and V) are generally higher than the trace element contents of residual fuel oils used for power generation.

PYROLYSIS AND CRACKING

44237 Infrared absorption study of coal-metal salt catalyst interactions. Lee, J.M. (Auburn Univ., AL); Wood, R.E.; Wiser, W.H. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* 23: No. 1, 275-283(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Infrared absorption is capable of differentiating some types of bonds affected by pyrolysis of coal in the presence of metal salts. Further, these salts do not act uniformly with respect to specific bonds. This is especially apparent in the cases of $ZnCl_2$ and $SnCl_2$, both of which are effective as coal hydrogenation-liquefaction catalysts. $ZnCl_2$ acts to decrease the absolute content of aromatic hydrogen bonding while $SnCl_2$ acts to increase the absolute quantity of aromatic hydrogen in the char.

BY-PRODUCTS

44238 Procedure for producing hydrogen chloride from a gas stream. Loyless, J.E. (to Vulcan Materials Co., Birmingham, AL (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,610,851/A/. 28 Oct 1976. 21p. (In German).

An improved method for the production (recovery) of hydrogen chloride from gas flows containing chlorinated hydrocarbons with 1-2 C atoms, such as chloromethane, is described. The whole gas flow is condensed to the liquid phase serving as charge and is fed to a stripping zone. The pressure and temperature are adjusted so that the whole amount of chlorinated hydrocarbon is retained in a liquid phase and practically all the hydrogen chloride is separated off as vapour phase. The pressure in the stripping zone is maintained at more than 10,5 kg/cm²/a (150 psia).

44239 Process for extracting purified aromatic hydrocarbons from light oils from the coke-oven. Maerker, J.B.; Shalit, H.; Weiss, A.H. (to Air Products and Chemicals, Inc., Philadelphia, PA (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 1,470,573/C/. 6 Feb 1975. 7p. (In German).

The invention concerns a method to extract purified aromatic hydrocarbons from coke oven light oils, particularly to remove polymerizable impurities with components forming resin-type and/or carbon-containing deposits from these oils.

PROPERTIES

REFER ALSO TO CITATION(S) 44224, 44229, 44236, 44237, 44272, 44278, 44281, 44718

44240 (FE—2278-11) Phase equilibrium and volumetric properties of coal-derived fluids. Quarterly report, September 16—December 15, 1978. Robinson, R.L. Jr. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1978. Contract EX-76-C-01-2278. 16p. Dep. NTIS, PC A02/MF A01.

Data have been obtained at 100°C on the volumetric properties of three binary gas systems: hydrogen + methane, hydrogen + carbon dioxide and methane + carbon dioxide. Interaction virial coefficients evaluated from these data are estimated to be precise to +- 0.5 cc/gmol. In the vapor—liquid equilibrium study, the equipment and analytical techniques have been refined and data acquisition has begun. K-values have been measured at 220°F and pressures from 200 to 2,000 psia on the multicomponent system methane, ethane, propane, toulene, 1-methylnaphthalene. Precision of the data is estimated to vary from 2% for methane to 10% for 1-methylnaphthalene.

44241 (FE—5065-4) Prediction model for compositional changes within a coal from core data. 4th quarterly report, April—June 1977. Renton, J.J.; Donaldson, A.C. (West Virginia Univ., Morgantown (USA). Dept. of Geology). 1977. Contract EY-76-S-05-5065. 11p. Dep. NTIS, PC A02/MF A01.

The work accomplished so far has definitely established that the compositional variability on a within-a-mine basis is systematic. Patterns have been established for the parameters investigated, most of which can be explained at this stage by basic geological processes. Interrelationships have been statistically tested between inorganic parameters and between the inorganic and organic components. The more regional study is evolving and a basic regional model has been tentatively established.

44242 Charge transfer complexes of coal-derived asphaltenes. Schwager, I.; Kwan, J.T.; Miller, J.G.; Yen, T.F. (Univ. of Southern California, Los Angeles). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* 23: No. 1, 284-289(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Coal-derived asphaltenes were separated by solvent fractionation from coal liquids produced in five major demonstration liquefaction processes: Synthoil, HRI H-Coal, FMC-COED, Catalytic Inc. SRC, and PAMCO SRC. The asphaltenes were further separated into three fractions by exhaustive solvent elution chromatography on silica gel using the solvents: benzene, diethyl ether, and tetrahydrofuran. The benzene and diethyl ether eluted fractions, known to contain a higher and lower proportion of basic asphaltene molecules, were used in addition to starting asphaltene to form some of the complexes. Complexes were formed by mixing benzene solutions of the asphaltenes (-50 g/l) with benzene solutions of either iodine or tetracyanoethylene (freshly sublimed reagent grade) in the approximate mole ratios, asphaltene/acceptor = 0.7 to 1.0/1. A precipitate forms rapidly. It was filtered, washed with benzene and dried overnight at 40°C/2 mm Hg. The dark brown to black I_2-asphaltene complexes are relatively insoluble in benzene, carbon disulfide, and pentane, and slightly to moderately soluble in chloroform and tetrahydrofuran. The brown-black TCNE-asphaltene complexes are only moderately soluble in THF. Analyses were performed by the ELEK Microanalytical Laboratories, Torrance, California.

44243 Introduction to the occurrence of mineral matter in coal. Gluskoter, H.J. (Illinois State Geological Survey, Urbana). pp 3-19 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Interest in trace elements and mineral matter in coals, especially the potentially detrimental effects of these materials on equipment and on the environment during coal utilization and their impact on availability of energy, has recently increased. The phrase mineral matter in coal usually refers to mineral phases or species in coal and to all chemical elements in coal that are generally considered inorganic, even if they are present in organic combination. The principal minerals in coals are aluminosilicates (kaolinite, illite, and mixed-layer clay minerals); sulfides (primarily pyrite and marcasite); carbonates (calcite, siderite, and ankerite or ferroan dolomite); and quartz.

44244 Analysis of mineral matter in coals of the Ruhr under gasification conditions. Plogmann, H.; Mackowsky, M.T. (Bergbau-Forschung GmbH, Essen, Germany). pp 21-37 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The mineral matter in coal from the Ruhr region of Germany consists primarily of a mixture of clay minerals, carbonates, iron sulfide, and quartz. The melting behavior of the mineral matter in combustion processes, tested by conventional means, defines softening temperatures and sintering temperatures that are important indicators of the temperature range at which agglomeration or caking of ash may cause the formation of deposits. Gasification experiments were performed with an apparatus that allowed the simulation of allothermal fluid bed gasification conditions. Although the experiments were carried out at bed temperatures at which the highest temperatures of the heater could not reach the ash sintering temperatures, deposits were frequently formed at the heater. Subsequent experiments under gasification conditions with steam and pressure were found to increase melt formation and lower viscosity.

44245 Variations in organic constituents of some low rank goals. Miller, R.N.; Given, P.H. (Pennsylvania State Univ., University Park). pp 39-50 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Twenty to thirty elements have been determined at many levels in 4 drill cores and in various specific gravity fractions of a fifth sample. The data have been analyzed statistically. A number of elements (e.g., Ca, Na, K, Sr, Mg, Mn) are present in ion exchangeable form attached to organic acid groups. Other elements (e.g., Al, Ti, Be, V) appear to be present partly as chelated organometallic complexes decomposable by dilute mineral acid. The major part of the Mo in the samples is associated with the mineral pyrite. Another group of elements (e.g., Si, Al, K, Mg, Zr) are evidently associated with detrital minerals. Variations of elements within seams are discussed. Some practical implications of these findings are pointed out.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 44272, 44285

44246 (BNL—50944) **Regenerative process for desulfurization of high temperature combustion and fuel gases. Quarterly progress report No. 10, July 1—September 30, 1978.** Shen, M.S.; Chen, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 72p. Dep. NTIS, PC A04/MF A01.

A kinetic study has been performed with a rotary kiln reactor of the apparent solid—solid reaction between the sulfated limestone and the fly ash from a FBC. The experimental conditions were within the range for regeneration of the lime-based sorbents for fluidized-bed combustion. The measured SO_3 concentrations have been favorably interrelated with a derived mathematical model, with the major operating variables of the reactor such as solid loading, temperature, gas flow rate, etc. The kinetic parameters of the regeneration reaction, the maximum attainable SO_2 concentrations, and the effect of the molar ratio of C/S on the extent of $CaSO_4$ conversion to CaO have been obtained. Calcium silicates have been shown to have very favorable thermodynamic properties for regeneration. In contrast to limestones, β-dicalcium silicate retained its activity when repeatedly cycled between sulfation and regeneration. An economic comparison between an AFBC once-through limestone sorbent system and a kiln regeneration system has been made. A kiln reactor process for regenerating sulfated calcium oxide reduces the environmental impact of fluid bed waste disposal and improves natural resource utilization. Also, in consideration of the higher capital and operating costs for recovering liquid sulfur, a combined kiln regeneration/sulfuric acid process appears to be economically superior to a once-through sorbent and to a kiln regeneration/sulfur process, provided the acid can be sold in the vicinity of the power plant producing it.

44247 (FE—2240-50) **Sulfur recovery in a coal gasification plant.** Chia, W.S.; Todd, F.A. (Braun (C.F.) and Co., Alhambra, CA (USA)). Aug 1978. Contract EX-76-C-01-2240. 66p. Dep. NTIS, PC A04/MF A01.

For the western coal feed, the combination of a non-selective Selexol process for acid gas removal, FMC Double Alkali process for flue gas cleanup, and a Stretford process for sulfur recovery, was the most economical among the cases studied. For the eastern coal case, a selective Selexol unit with a Claus unit for sulfur recovery and FMC Double Alkali process flue gas treating was the most economical. The combination of a Claus unit with Beavon mark I, selective Selexol, and FMC Double Alkali flue gas processes was also found economically competitive on eastern coal feed. The FMC Double Alkali process was used in this study. The selection of this process was the result of another Braun study. The conclusions of this study would not be greatly affected by choice of flue gas treatment by any of the lime or limestone scrubbing processes considered in that study. The conclusions in this report are based on the BCR BI-GAS process as prepared by Braun for the commercial concept factored estimates. They may be extended to the other high pressure processes in those reports. For the CO_2 Acceptor, Lurgi ad Steam Iron HYGAS processes, the raw gas pressure, composition or distribution may be sufficiently different to require another choice of process schemes.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44216, 44265, 44269, 45379, 45403, 45404, 45405, 45460, 45464

44248 (CONF-790371—1) **Status of development, energy and economics aspects of alternative technologies.** Farber, P.S.; Livengood, C.D.; Wilzbach, K.E.; Buck, W.L.; Huang, H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 49p. Dep. NTIS, PC A03/MF A01.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Several energy technologies are under development throughout the world which either totally negate the need for flue gas desulfurization (FGD) or require less than full flue gas scrubbing. These processes remove sulfur either prior to coal combustion (coal cleaning or conversion), during combustion (atmospheric and pressurized fluidized-bed combustion), or between two combustion stages (gasification combined-cycle operation). This paper reviews the status of development and/or demonstration of these technologies with respect to their possible application to the generation of electricity. In addition to this, the overall coal to electrical energy efficiency and economics (capital costs and total annualized costs, mills/kWh) are explored, and compared for the various alternatives. The economic premises utilized will, as much as possible, conform to those used by the TVA in comparisons of FGD technology. The paper shows, among other things, the importance in any energy and economic analysis of an energy system, be it a postcombustion treatment process (FGD) or the total energy process (FBC), of taking into account the cost of fuel and the overall process energy efficiency.

44249 (FE—2445-1(Vol.2)) **Water related environmental effects in fuel conversion. II. Appendix volume.** Gold, H.; Goldstein, D.J. (Water Purification Associates, Cambridge, MA (USA)). 1977. Contract EX-76-C-01-2445. 674p. Dep. NTIS, PC A99/MF A01.

This report examines some water related effects that could be expected from siting specific conversion plants at given locations in the major coal and oil shale bearing regions of the United States. A total of 90 plant-site combinations were studied: 48 in the Central and Eastern regions and 42 in the Western region. The synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low sulfur fuel oil; coal refining to produce a de-ashed, low sulfur solvent refined (clean) coal; and oil shale retorting to produce synthetic crude. The results presented include the range of water requirements, the conditions for narrowing the range and optimizing the use of water, the ranges of residual solid wastes, and the cost and energy requirements for wastewater treatment. A comparison of the water requirements with those of two recently published studies shows widely varying estimates and emphasizes the need for both site- and design-specific calculations. A general assessment of the water resources data in the coal and oil shale regions was made. Potential water supply sources for each site were evaluated in terms of the available water supply. The degree of wet cooling used to dissipate waste heat was determined on the basis of water availability and cost.

44250 (FE—2495-T13(Vol.1)) **Guidelines for multimedia environmental monitoring of Department of Energy fossil energy RD and D facilities.** Rolan, R.G. (Dalton-Dalton-Little-Newport, Cleveland, OH (USA)). Nov 1978. Contract EX-76-C-01-2495. 185p. Dep. NTIS, PC A09/MF A01.

These guidelines outline a procedure for the detailed design and specification of environmental monitoring projects relating to all fossil energy technology research, development and demonstration (RD and D) facilities funded by the Department of Energy (DOE), as well as a procedure for determining when and how much of such monitoring is appropriate. Fossil energy RD and D facilities require environmental monitoring for two basic reasons, the first related to compliance with federal, state, and local laws and regulations, and the second related to the programmatic aspects of developing environmentally acceptable ways of using fossil fuels. With respect to compliance, DOE is required by federal law and presidential executive order to monitor any of its facilities which have a National Pollution Discharges Elimination System permit (for water) and/or a New Source permit (for air). In addition, it is desirable for DOE to demonstrate, through monitoring, that is in compliance with all applicable standards and regulations in order to promote public acceptance of advanced fossil energy technologies. Such monitoring will permit DOE to protect the public health, safety, and welfare by modifying operations if ambient environmental conditions produced by a given facility exceed tolerable limits.

44251 (FE—2495-T13(Vol.2)) **Guidelines for multimedia environmental monitoring of Department of Energy fossil energy RD and D facilities.** Rolan, R.G. (Dalton-Dalton-Little-Newport, Cleveland, OH (USA)). Nov 1978. Contract EX-76-C-01-2495. 483p. Dep. NTIS, PC A21/MF A01.

Having described the kinds of potential environmental impact generators from DOE fossil energy facilities, the potential sensitivity of the environment to these generators is examined as a step in selecting parameters which should be monitored. Basic ecological concepts and terminology that will be needed in properly designing a monitoring program for a DOE fossil energy RD and D facility are introduced. Chapter V deals primarily with analytical hardware options available for such monitoring, sampling and analytical meth-

ods, data recording, processing and retrieval, and with data quality control and assurance. In general, this chapter does not deal with ways to select among the options available. Some choices, however, are obvious. For example, some EPA-approved monitoring technologies are required by law. Beyond that, EPA-approved methods are generally recommended because that agency has put more effort into developing and/or validating monitoring methods than any other public or private organization.

44252 (PB—284336) **EPA program status report: Synthetic fuels from coal, including process overview with emphasis on environmental considerations.** Altschuler, M.; Eckstein, L.; Hook, C.O.; Roe, D.E.; Zalkind, J. (Cameron Engineers, Inc., Denver, CO (USA)). Jul 1977. Contract EPA-68-01-4337. 113p. NTIS PC A06/MF A01.

The status of EPA's Synthetic Fuels from Coal Program as of July 1977 is presented. Processes with emphasis on environmental considerations are also described. This program is a part of EPA's interagency energy-related environmental research program directed toward providing the necessary technology for meeting near-term and long-term energy requirements in an environmentally acceptable manner. The objective of the program is to assess the environmental impacts from processes for producing synthetic fuels from coal, and develop appropriate pollution-control technology.

44253 (PB—286796) **Our reclamation future, the missing bet on trees. Final report.** Ashby, W.C.; Kolar, C.; Guerke, M.L. (Southern Illinois Univ., Carbondale (USA). Dept. of Botany). Jan 1978. 108p. NTIS PC A06/MF A07.

The authors have found many reasons to recommend tree planting as a desirable reclamation alternative. The data base is a survey conducted in 1976 of tree plantings thirty years old on mined lands. These plantings were experimental plots established by the strip-mine research unit of the USDA Forest Service in 1947 or later in cooperation with the coal industry, plus some coal company plantings. In the survey the authors measured 13.236 on 134 plots and took 785 soil samples. The success of tree planting for reclamation reported in earlier studies was sustained and enhanced over a thirty-year period. The total area presently in forest represent 18 million trees planted by the coal industry in past years, and volunteer trees such as cottonwood which come in naturally on the fresh mineral-rich soils.

44254 (PB—286870) **Texas lignite: environmental planning opportunities.** Cloud, T.J. Jr. (Fish and Wildlife Service, Fort Collins, CO (USA). Western Energy and Land Use Team). Jun 1978. 19p. NTIS PC A02/MF A01.

The report discusses aquatic, terrestrial, and recreational environmental impacts resulting from lignite development in Texas. It then goes on to discuss various opportunities for proper environmental protection measures, such as involving concerned agencies and the public in planning, the establishment of reclamation plans, and the development of information regarding the environmental requirements of plant and animal species.

44255 (PB—286996) **Overburden mineralogy as related to ground-water chemical changes in coal strip mining. Final report, December 1975—December 1977.** Hounslow, A.; Fitzpatrick, J.; Cerrillo, L.; Freeland, M. (Colorado School of Mines, Golden (USA). Research Inst.). Aug 1978. 319p. NTIS PC A14/MF A01.

A research program was initiated to define and develop an inclusive, effective, and economical method for predicting potential ground-water quality changes resulting from the strip mining of coal in the Western United States. To utilize the predictive method, it is necessary to sample the overburden, determine its mineralogical content, and, where applicable, to determine the quality of the ground water that may saturate the spoils. Techniques were developed for interpreting the data required to predict future groundwater quality changes. With additional research, the predictive method may also be found applicable to other types of mining operations. Relationships among and between rock and water variables were established using factor analysis. This analysis, coupled with thermodynamic calculations, provided rational explanations of the facts observed in the study of existing mines.

44256 (PB—288210) **Source assessment: coal refuse piles, abandoned mines and outcrops, state-of-the-art. Final report Aug 1975—Jul 1977.** Chalekode, P.K.; Blackwood, T.R. (Monsanto Research Corp., Dayton, OH (USA)). Jul 1978. Contract EPA-68-02-1874. 52p. NTIS PC A04/MF A01.

This report describes a study of atmospheric emissions from coal refuse piles, abandoned mines, and outcrops. The potential environmental effect of the source was evaluated using source severity (defined as the ratio of the maximum time-averaged ground level concentration of an emission to a hazard factor). Burning of coal piles, impoundments, abandoned mines, and outcrops results in emissions of various pyrolysis and combustion products such as particulates, nitrogen oxides, sulfur oxides, carbon monoxide, hydrogen sulfide, ammonia, polycyclic organic materials (POM), and hydrocarbons, including benzene, toluene, and xylene. Trace elements such as arsenic, boron, and mercury are also emitted.

44257 (PB—288234) **Pollutant emissions from 'dirty' low- and medium-Btu gases. Final report May 1977—Apr 1978.** Waibel, R.T.; Fleming, E.S.; Larson, D.H. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1978. Contract EPA-68-02-2643. 86p. NTIS PC A05/MF A01.

The report gives results of a study to determine the emissions from 'dirty' low- and medium-Btu gases when combusted on industrial process burners. The fuels tested were blends with compositions typical of Wellman-Galusha oxygen (WGO) and air (WGA) fuel gases. Baseline data were collected for natural gas, ambient WGO and WGA, and hot WGO (700 K) and WGA (616 K). Ammonia, H2S, coal tar, and char were added to the hot fuels to determine their effects on pollutant emissions. Study conclusions include: (1) low-Btu fuels not subjected to post-gasifier cleanup can yield NOx levels greatly above the thermal levels for the clean fuels and for natural gas; (2) in turbulent diffusion flames, fuel-NOx increases with an increase in (a) the amount of fuel-nitrogen, (b) the amount of fuel-sulfur, (c) the level of excess air , and (d) the degree of initial fuel/air mixing; (3) attempts to close the fuel-sulfur balance were unsuccessful (further work should be done in this area); and (4) compared to natural gas, heat transfer to the load is reduced for the low-Btu fuels tested (this heat transfer is not greatly affected by the presence of contaminants--tar and char--at levels characteristic of raw gasifier effluents).

44258 (PB—288313) **Water-related environmental effects in fuel conversion. Volume I. Summary. Final report Oct 1976—Sep 1978.** Gold, H.; Goldstein, D.J. (Water Purification Associates, Cambridge, MA (USA)). Oct 1978. Contracts EPA-68-03-2207;DOE-EX-76-C-01-2445. 247p. NTIS PC A11/MF A01.

The report gives results of an examination of water-related effects that can be expected from siting conversion plants in the major U.S. coal and oil shale bearing regions. Ninety plant-site combinations were studied: 48 in the Central and Eastern U.S. and 42 in the Western. Synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low sulfur fuel oil; coal refining to produce a deashed, low-sulfur solvent refined (clean) coal; and oil shale retorting to produce synthetic crude. Results presented include the range of water requirements, conditions for narrowing the range and optimizing the use of water, ranges of residual solid wastes, and cost and energy requirements for waste water treatment. A comparison of water requirements with those of two recently published studies shows widely varying estimates and emphasizes the need for both site- and design-specific calculations. A review of various combinations of cooling requirements indicates a factor of 4 difference in water consumption across all processes studied. Where water costs $<$ 25 cents/1000 gal., a high degree of wet cooling appears best. If $>$ \$1.50/1000 gal., a minimum of wet cooling should be considered. Between these, a more balanced mix needs to be reviewed. All water requirements of this study are based on complete water re-use; i.e., no direct water discharge to streams or rivers.

44259 **Trace element effects of energy conversion facilities: a phase one final report to the Old West Regional Commission.** Miller, J.K.; Christianson, G.A.; Schock, M.R.; Morrison, W.W. Billings, MT; Old West Regional Commission (Nov 1977). 204p. (NP—23774).

This study was performed in a 2400 square mile area of western North Dakota to evaluate the potential significance of 15 trace elements (As, Be, Cd, Cr, Cu, F, Pb, Hg, Mo, Ni, Se, S, U, V, Zn) released to the environment through the energy conversion of coal. The methodology for evaluating these trace elements included the analysis of coal from four coal mines; the study of operating histories and design parameters of six lignite-fired electrical generating facilities; and the analysis of soil taken from 205 locations within the study area. The concentration of trace elements in the coal and facility design parameters served as input data for a climatological dispersion model with a deposition function for estimating the dry deposition of trace elements to the study area. Trace element deposition was compared to existing soil concentrations. The application of a climatological dispersion—deposition model demonstrated that modern era energy conversion facilities contribute three orders of magnitude less surface deposition than do energy conversion facilities designed and operated since the 1920's. This report presents a methodology for determining the significance of individual trace elements released to the environment through the energy conversion of coal. For short-term (annual projections), the projected depositions on environmental receptors are not expected to cause adverse effects on ecosystems. However, the potential long-term environmental significance of the quantities of these trace elements deposited to the environment remains for further evaluation.

44260 Weather modification potential of coal-fired power plants. Billings, MT; Old West Regional Commission (1977). 141p. (NP—23775).

The measurements indicate that the outputs from the two coal-fired power plants studied are not of concern for inadvertent weather modification. The major uncertainty in this conclusion is due to the lack of valid measurements of ice nuclei because of the importance played by the ice phase in precipitation in this region. Although the measurements taken imply that the plants are not an important source of ice nuclei, these and other current measurments of ice nuclei are of questionable validity because of the failure to observec the expected behavior of these nuclei in clouds. The Cloud Condensation Nuclei (CCN) concentrations were of such a magnitude that small effects in a limited region downwind of the plants could not be ruled out. It is very doubtful that the effects could be even comparable to the natural year-to-year variability in the precipitation, and the effects are probably negligible. However, if CCN concentrations were to increase an order of magnitude (because of either larger or more numerous plants), significant decreases in the precipitation in the region downwind from the plants for at least 100 km would probably result. The particulate emissions from the plant would also have a negligible effect on the radiation balance of the atmosphere. Here also, an order-of-magnitude increase would probably begin to create measurable changes in precipitation. The effects of the heat and water vapor outputs on the development of precipitation were negligible for the plants studied, and would probably be negligible for plants ten times as large. Extrapolation of the results to larger plants is perilous because of the non-linear nature of many of the emission processes, but the indications are that no serious effects on the weather are likely to result from the plants studied or limited numbers of additional similar plants.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 44241

44261 (ORO—5065-3) **Prediction model for compositional changes within a coal from core data. 3rd. quarterly report, January—March 1977.** Renton, J.J.; Donaldson, A.C. (West Virginia Univ., Morgantown (USA). Dept. of Geology). 1977. Contract EY-76-S-05-5065. 68p. Dep. NTIS, PC A04/MF A01.

Analysis of 347 samples from the study mine have been completed and preliminary synthesis has begun. The information generated to date indicates that systematic variation in compositional parameters does exist within the mine; that is, the compositional parameters form three dimensional patterns. The patterns observed so far indicate that different processes are responsible for the distribution of different parameters. The ash distribution appears to be influenced by paleodepositional processes, while the sulfur patterns strongly suggest post depositional processes. Interrelationships have been established between the organic makeup of the coal and certain inorganic constituents. The bright coal is rich in kaolinite while the dull coal shows preferential concentration of illite. Organic sulfur also shows preference for the vitrinite-rich lithotypes. Differences exist within the pyrite in coal apart from morphology. X-ray Bragg reflections are more intense from pyrite contained within the bright coal than that contained within the dull coal. The reason is unknown. Regional investigations have shown definite patterns of coal deposition strongly influenced by the pre-swamp sedimentation, especially due to the presence of the Gilboy sand which is the major sand deposited by the pre-coal fluvial system in the study area. The petrographic study has shown that the coal lithotypes show degrees of lateral continuity similar to the non coal units although of different magnitude.It does however demonstrate that the lithic units can be used to determine the lateral extent of swamp geometry and the persistence of depositional environments within the swamp - if admittedly in a gross way.

MINING

REFER ALSO TO CITATION(S) 44254, 44255, 45379

44262 (CONF-7810155—) **Proceedings of the second workshop on the Energy Development Board of Mercer Country, North Dakota.** (Department of Energy, Washington, DC (USA). Office of Building and Community Systems). Feb 1979. 42p. Dep. NTIS, PC A03/MF A01.

From 2. workshop on energy development board of Mercer County ND; Bismark, ND, USA (26 Oct 1978).

With energy demand increasing, production of electricity from coal-fired power plants has become an important industry in Mercer County. The second workshop focused on the activities of the Energy Development Board. Specifically, participants at the workshop discussed the growth management plan and several of its major components - the economic diversification program, the energy conservation program, and the socio-economic monitoring program. In addition, participants discussed a variety of mechanisms for providing impact assistance to areas undergoing energy development. This report summarizes the recommendations of the five panel sessions. Additional information on the workshop and the EDB is provided in 3 appendices. (MCW)

44263 (PB—288231) **Study of mine fires and mine ventilation. Part I. Computer simulation of ventilation systems under the influence of mine fires. Contract research report 4 Jun 1974—14 Oct 1977.** Greuer, R.E. (Michigan Technological Univ., Houghton (USA). Dept. of Mining Engineering). Oct 1977. Contract S0241032. 165p. NTIS PC A08/MF A01.

An existing computer program for mine ventilation network is modified so that it can simulate ventilation conditions under the influence of mine fires. New program parts considered are methane productions in coal mines, heat and gas productions of mine fires, temperature and air composition changes in ventilation systems, and the ventilation forces resulting from the latter. Other program parts are provided for the detection of danger zones and reversed air currents and for the inclusion of recirculated air currents in the network analysis. The resulting new program is designed for the practical ventilation engineer and should be applicable to all types of ventilation emergency plans, in particular mine fire plans. The organization of the program and its mathematical basis are described. A Fortran IV listing and several flow diagrams are included. Eight executed examples are discussed, input and output for these examples explained. Storage requirements and execution times are estimated.

44264 (PB—288298) **Improved fire protection system for underground fueling areas. Volume 1. Final report Jun 1976—Sep 1977.** Christensen, B.C.; Reid, G.R. (Ansul Co., Marinette, WI (USA)). 20 Sep 1977. Contract H0262023. 325p. NTIS PC A14/MF A01.

The objectives of the investigation are to develop safe practice guidelines that will minimize the chance of fires in underground fueling areas and to develop a low-cost, reliable, automatic fire protection system for underground fueling areas. The effort described covers the period from June 21, 1976 to September 30, 1977, and accomplished the following tasks: (1) Preparation of data plan and data acquisition, mainly through visits to 16 mine sites and a literature survey; (2) Analysis of the accumulated data, providing design inputs for evaluation of the fire problem, development of safe practice guidelines, and development of recommended design concepts for automatic fire protection systems; (3) Preparation of safe practice guidelines for underground fueling areas; (4) Preparation of recommended design concepts for automatic fire protection systems for underground fueling areas; (5) Design and fabrication of fire protection system for installation at Pine Creek mine, Bishop, California; and (6) Install system and perform underground fire tests at Pine Creek mine.

44265 (PB—288383) **Potential of coal strip-mine spoils as aquifers in the Powder River Basin. Final report 1974—1976.** Rahn, P.H. (South Dakota School of Mines and Technology, Rapid City (USA)). 30 Jun 1976. Contract OWRC-10470025. 119p. NTIS PC A06/MF A01.

This report provides guidelines for determining the potential of stripmining fills as underground aquifers and water storage areas in the Powder River Basin. Also contains data which (1) establishes the porosity-permeability of selected spoils; (2) establishes the composition of spoils and effects on water composition; (3) establishes the composition of water in the spoils; (4) establishes the groundwater recharge, discharge, and flow direction; and (5) establishes potential areas where recharge of these backfilled spoils are feasible. (Portions of this document are not fully legible)

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 44208, 44220, 45002

44266 (FE/EES—79/3) **Coal-oil mixture: transportation factors.** Campbell, T.C. (Department of Energy, Morgantown, WV (USA). Process Evaluation Office). Jan 1979. 14p. Dep. NTIS, PC A02/MF A01.

Coal transportation costs are significant portions of the prices paid by users and necessarily are a contributing factor in determining optimum plant sizes and locations of COM mixing facilities and the market areas to be supplied by each facility. Residual fuel oil, on the other hand, is available at refineries located in nearly all regions of this country. An exception to this is the East Coast, where much of its residual fuel oil is imported from offshore refineries. Because of the different supply patterns of coal and fuel oil, coal apparently will have to be moved longer distances to some of the prospective COM mixing facilities than will the oil. Costs for shipping the coal vary

because of mode of haul and of distances and quantities hauled. For example, rates per ton vary from about $2 to more than $5 per ton between single-car and unit-train shipments. The spread between these rates tends to increase as the distances hauled increase. Because of this, costs encountered by mixing plants that can cope with large coal deliveries will be significantly lower than for those that must receive the coal in small lots of one or a few cars at a time. Further study of these matters, along with other technological and marketing factors, is needed in order to determine the optimum plant size and the market to be served. While certain general rules can be stated, each proposed plantrequires specific study and analysis because of differences in both its sources of coal and residual fuel oil and the market that will consume the COM as it is processed and delivered.

44267 Computer simulation of coal preparation plants. Gottfried, B.S.; Abara, J. (Univ of Pittsburgh, Pa). *Comput. Chem. Eng.;* **2**: No. 2-3, 99-107(1978).

Coal preparation is a procedure for removing physical impurities, such as ash and pyritic sulfur, from freshly mined coal. This study describes the development of a computer simulation model for predicting the performance of coal preparation plants. The model allows the user to interconnect individual plant components into whatever configuration may be of interest. A provision for recycle streams is also included. A discussion is presented of the computational methods used for each of the unit operations, and a description of the executive routine. Several examples are presented which illustrate the use of the simulator to verify theoretical predictions and to predict the performance of a realistic plant configuration.

COMBUSTION

REFER ALSO TO CITATION(S) 44223, 44719, 44723, 45123

44268 (DOE/ET/10320—1) **Studies for the stabilization of coal—oil slurries (COM). Technical progress report , August—November 1978.** Botsaris, G.D.; Glazman, Y.M.; Naar, R.Z.; Viola, M.A. (Tufts Univ., Medford, MA (USA). Dept. of Chemical Engineering). 29 Nov 1978. Contract ET-78-S-01-3128. 30p. Dep. NTIS, PC A03/MF A01.

Equipment for measuring viscosities, grinding and classifying coal powders, grinding COM, and blending rubber and coal were obtained. Coal samples covering the whole spectrum of ranks as well as oils for the whole investigation were procured. Coal surface characterization by the so-called Bound Rubber Test and heats of immersion were investigated. The development of tests for COM stability characterization according to our model was initiated.

44269 (FE—1536-T3) **Energy conversion from coal utilizing CPU-400 technology. Research and development report No. 94. Quarterly report No. 2, October—December 1974.** (Combustion Power Co., Inc., Menlo Park, CA (USA)). Feb 1975. Contract EX-76-C-01-1536. 37p. Dep. NTIS, PC A03/MF A01.

With suitable parametric controls, both SO_2 and NO/sub x/ can be adequately suppressed in the PDU to meet EPA emission standards. Calcination of the dolomite is prerequisite to good sulfur suppression, and this in turn requires that high temperatures (> 1510°F) be maintained in the freeboard and beyond. Plugging of the inertial separators is greatly aggravated by cementation of the particulate, for which lowered temperature is a major causative factor; thus, the temperature drop from the combustor to the outlet from the second-stage inertial separators must be held to the minimum practicable. Adequate removal of particulate from the exhaust gases has not been possible with cyclones or inertial separators alone. A granular filter thus appears to be a vital addition to the system. Coated turbine blades installed in the PDU as currently configured will have about a 600-hour life. Observations to date support a conclusion that hot corrosion - or sulfation - is a significant agent in limiting the life of high-temperature turbine blading. Thus further testing of this phenomenon seems essential.

44270 (FE—1726-20A) **Engineer, design, construct, test and evaluate a pressurized fluidized bed pilot plant using high sulfur coal for production of electric power. Phase I: preliminary engineering, commercial plant conceptual design.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). 15 Mar 1977. Contract EX-76-C-01-1726. 109p. (CW-WR—76-015-20A). Dep. NTIS, PC A06/MF A01.

A promising approach for production of environmentally clean and cost-competitive electric power generation from coal with improved power cycle efficiency involves the application of a pressurized fluidized bed (PFB) combustor to a combined cycle. A conceptual design of a 500 MW base load power station was prepared which used high (> 3%) sulfur coal in the presence of a sulfur sorbent (dolomite) material. The gas turbine in this system provides one-third of its compressor airflow to the fluidized bed for coal combustion and the balance of flow to the in-bed heat exchanger. The plant which has a thermal efficiency of 40 percent is modularized with three pairs of gas turbines, each driving a 100 MW alternator for a total of about 300 MW. The waste heat recovery boilers (one per gas turbine) produces a total of 1,600,000 lb/hr steam which drives one 200 MW steam-generator set. A cost analysis shows the plant capital cost is $640/kw. An economic feasibility study shows the PFB combined cycle is at least 10% lower in cost of generating electricity than a pulverized coal conventional boiler and over 30% lower than an oil fired boiler. The report describes the PFBC combined cycle plant arrangement, the equipment design configuration, and plant performance.

44271 (M—78-68(Vol.2), pp 4-13) **State of the art resume.** Smith, A.A. (Babcock and Wilcox, Ltd., England). Dec 1978.

From 5. international conference on fluidized bed combustion; Washington, DC, USA (12 Dec 1977).

Company programs and plans in fluidized-bed combustion are described. (LTN)

44272 (M—78-68(Vol.2), pp 655-676) **Characterization of efflux from a pressurized fluidized bed combustor.** Bekofske, K.; Giles, W.; Thoennes, C. Dec 1978.

From 5. international conference on fluidized bed combustion; Washington, DC, USA (12 Dec 1977).

A characterization of PFB efflux is necessary for specifying the performance of the required hot-gas particulate cleanup system. The efflux characterization is discussed in terms of particulate loading, particle size distribution, chemical content and mechanical characteristics. Data indicate rapidly increasing dust loading with superficial velocity. Although a correlation between particle size distribution and superficial velocity is not apparent, the size distribution does appear to depend heavily on the geometry of the combustor. Thermochemical calculations indicate vapor phase alkali concentrations of 2 to 4 ppM, and these have been measured in the range of 1 to 8 ppM but generally about 2 ppM. The carryover material is likely to be sticky to the extent that gas turbine and cleanup equipment fouling should be considered potential problems.

44273 Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978). 703p. (CONF-770670—).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Separate abstracts were prepared for 39 of the 40 papers presented. One paper was previously included in the data base. (WHK)

44274 Electricity industry assessment of low btu gas for power generation. Gluckman, M.J.; Quentin, G. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 1, 157-171(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Coincident with the fuel crunch, the utility industry is being confronted by an equally serious and difficult to handle environmental crunch. Coal gasification offers the potential for controlling SO/sub x/, NO/sub x/ and particulate emissions in a far more efficient and less costly manner than can be achieved in pulverized coal boilers. There are a variety of different ways in which the utility industry can employ the concept of coal gasification for electric power generation. Some of the more obvious options are shown in table 1. The information presented indicates that the two forms of integrated retrofitting discussed in this paper have the potential for providing attractive options for the electric utility industry to replace oil and gas firing with coal gasification in a low risk and timely manner. A number of unanswered technical and economic question have to be resolved before these options can be given serious consideration. New coal gasification, combined-cycle power plants are also discussed, particularly with respect to the coal gasification process.

44275 Criteria for selection of coal additives. Libutti, B.L.; Pall, R.L. (Drew Chemical Corp., Boonton, NJ). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 1, 206-213(1978). (CONF-780305—P6).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The corrosive components of superheater deposits may be chemically treated by a wide range of materials, both acidic and basic. They include magnesia, alumina, titania, silica and rare earth oxides and their combinations. Only those additives which form high-melting friable products with the alkali iron sulfates in the presence of a matrix of bulk ash should be used. It is not possible to predict suitability from composition at this time. Suitable additives may be selected empirically by studies such as the present one using samples of the appropriate deposits. Suppliers and boiler operators must then work in close cooperation to apply the additives in such a way that maximum benefits may be achieved. Only with such

cooperation may the difficulties inherent in a high-ash fuel be overcome.

44276 Microscopic investigation of the behavior of inorganic material in coal during combustion. Shibaoka, M.; Ramsden, A.R. (CSIRO Minerals Research Labs., North Ryde, New South Wales). pp 67-75 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The behavior of mineral matter during the combustion of coal is discussed on the basis of (a) electron microscopic observations of samples taken from a pilot-scale pulverized-fuel-fired furnace and (b) controlled combustion experiments on individual coal particles heated under a hot-stage light microscope and recorded by high-speed cine photography. The process of ash formation is influenced mainly by the chemical composition and thermal properties of the mineral matter and its mode of occurrence in the coal. Other factors involved include interaction between the inorganic and organic constituents of the burning coal particles and the physical and chemical environments through which these particles pass within the furnace.

44277 Research into the combustion and fouling behavior of brown coals. Hein, K.R.G. (Rheinisch-Westfalisches Electrizitatswerk AG, Essen, Germany). pp 77-83 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Fouling of the heat transfer surfaces of boilers in which fuels of low calorific value are burnt causes severe difficulties for power station operation. The deposit formation is strongly dependent on the composition of the fuel ash. The phenomenon of fouling can be influenced by operational parameters like excess air level and mixing between fuel and combustion air. Further research is necessary to quantify these tendencies in order to optimize boiler operation and ultimately improve power station availability.

44278 Ash fouling studies of low-rank western US coals. Sondreal, E.A.; Gronhovd, G.H.; Tufte, P.H.; Beckering, W. (Grand Forks Energy Research Center, ND). pp 85-111 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The mineral content in lignite and subbituminous coals in the Western US is distinctly different from that found in the bituminous coals of the East and Midwest. Most of the mineral content in lignite consists of alkali cations bound to the organic structure of the coal and of finely dispersed silica and aluminum silicates. Much of the low-rank Western US coal contains an appreciable sodium content which tends to flux the inherent mineral matter and cause serious ash fouling problems in power boilers. The ERDA Grand Forks Energy Research Center (GFERC) has studied ash fouling both in full-scale boiler tests and in a 34 kg/hr (75-lb/hr) test furnace. The most consistent results have been that the degree of fouling is a direct function of the sodium and ash contents of these coals. Silica in the ash tends to increase fouling and calcium is beneficial. A fouling mechanism for North Dakota lignite has been proposed.

44279 Fate of fuel nitrogen: implications for combustor design and operation. Heap, M.P.; Corley, T.L.; Kau, C.J.; Tyson, T.J. (Energy and Environmental Research Corp., Santa Ana, CA). pp 129-144 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The processes occurring during the combustion of fuels containing trace quantities of bound nitrogen are reviewed. Pyrolysis, heterogeneous and homogeneous reactions are considered. Experimental information on the interaction of fuel sulfur and fuel nitrogen compounds is presented. Limit case studies which consider chemistry to be the controlling phenomenon in fuel NO formation are presented for advanced power cycles burning coal-derived fuels.

44280 Direct mass spectrometric sampling of corrosion-related gaseous species from laboratory pulverized coal—air flames. Milne, T.A.; Beachey, J.E.; Greene, F.T. (Midwest Research Inst., Kansas City, MO). pp 217-231 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

An attempt to elucidate the nature and role of gaseous alkali and sulfur species in fireside corrosion and ash fouling is described. The approach chosen involves the direct molecular beam mass spectrometry of gaseous species sampled directly from small, aerodynamically simple, premixed, pulverized coal—air flames. Sampling by direct free-jet expansion through small orifices yields rapid quenching, high spatial resolution, and the ability to preserve such species as gaseous KOH and Na. The coal burner, sampling apparatus, and attempts to observe the initial rate of release and form of alkali and sulfur species in the primary flame zone are presented.

44281 Chemical transformations of the minerals in eastern bituminous coals under simulated pulverized coal firing conditions. Stinespring, C.D.; Zulkoski, M.; Mazza, M.H. (Morgantown Energy Research Center, WV). pp 233-241 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The transformation of coal minerals to ash under simulated pulverized coal firing conditions has been investigated for seven eastern bituminous coals. These coals were fired in a bench scale combustor and the resulting ash and deposits, as well as the original coals, were analyzed using x-ray diffraction and fluorescence. The transformations observed in this manner appear to be thermodynamically controlled. Evidence suggesting the existence of gas phase reactions leading to condensible sodium compounds has also been observed.

44282 Rational analysis of fireside deposits from brown coal fired boilers. Drummond, A.R.; Boar, P.L.; Deed, R.G. (State Electricity Commission of Victoria, Richmond). pp 243-251 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Brown coals from the Latrobe Valley in Victoria, Australia, are low in ash content (1 to 3%) and also in occluded mineral matter of which the major minerals are α-quartz, kaolinite and marcasite/pyrite. During combustion, a range of mineral compounds are formed in deposits; these are difficult to quantify if only the conventional approach to chemical analysis is taken. To assist in the assessment of deposit formation and the results of the use of removal techniques, an analytical scheme termed rational analysis has been developed which essentially combines the data obtained from x-ray diffraction studies or infra-red spectrometry with the chemical analysis of the deposits to give a pseudo composition for the compounds found in deposits. An integral part of the scheme is the quantitative determination of the α-quartz present in the deposit. As well as providing an easy method for comparing various deposits, new insights can be gained into the mode of deposit formation in the boiler by using the scheme. At present it is primarily applied to sulfatic deposits originating from the superheater region, although it is equally applicable to deposits formed elsewhere in the boiler. A modified scheme has also been used to give preliminary information on deposits formed from the combustion of other types of coal.

44283 Mechanism of sub-micron fly-ash formation in a cyclone, coal-fired boiler. Ulrich, G.D.; Riehl, J.W.; French, B.R.; Desrosiers, R. (Univ. of New Hampshire, Durham). pp 253-268 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Sub-micron fly-ash, because of its inordinate threat to public health, is receiving increasing attention. Through thermophoresis and selective enrichment, it may, as well, be more important in tube fouling and corrosion than the mass concentration suggests. Sub-micron ash is presumably formed by vaporization of certain metal-containing compounds at the burning coal surface followed by transport to the gas phase where nucleation and growth occur. The growth and morphology of sub-micron silica aggregates produced in a laboratory burner have been studied using laser light scattering and probe techniques. A growth model, based on collision and fusion rates, has been confirmed. Aggregates grow rapidly to a size of about 300 nm where a dramatic change in collision frequency occurs. The internal structure of the particle can vary from a chain-like aggregate of smaller primary units to a sphere, depending on the viscosity. Full-scale boiler studies and laboratory research are continuing. A method for computing the vapor composition at equilibrium has been refined. A comprehensive model for predicting the type of fly-ash generated from a given coal in a particular boiler is the goal.

44284 Studies of waterwall corrosion with staged combustion of coal. Manny, E.H. (Exxon Research and Engineering Co., Linden, NJ); Bartok, W.; Crawford, A.R.; Hall, R.E.; Vatsky, J. pp 387-399 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The combination of low excess air and staged firing combustion modifications is being employed successfully to reduce NO/sub x/ emissions in coal fired public utility boilers. Reducing atmospheres produced in the first stage of the combustion process resulting from this type of operation potentially are conducive to external corrosion of the furnace tubes. Corrosion data obtained using corrosion probes failed to provide an unequivocal resolution to the corrosion question due to the inability to relate probe data to actual furnace tube life. Consequently, Exxon Research and Engineering Company under EPA sponsorship initiated a long-term corrosion program using three methods of corrosion rate determination, i.e., (1) actual furnace tube panel test specimens; (2) a statistically designed pattern of ultrasonic furnace and panel tube measurements; and (3) corrosion probes exposed for varying periods. Corrosion probe data obtained in prior studies are reviewed and details of the long term corrosion probe test, now in progress, are discussed.

44285 Reduction of coal ash deposits with magnesia treatment. Radway, J.E. (Basic Chemicals, Cleveland, OH); Boyce, T.R. pp 401-414 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Magnesium oxide was successfully used during the early 1960's to minimize fouling of heat-absorbing surfaces on coal-fired boilers, but the dosages required, 0.4% to 3% of the fuel burned, were uneconomic. Recent trials employing fine particle size MgO dispersions on operating boilers firing widely different kinds of coal have yielded reductions in deposits and/or slag at very low treatment rates, 0.015% or less. This study was designed to quantify the results and possibly identify the mechanism by which these low levels of MgO achieved such favorable results. High and low temperature probes were used to obtain samples for examination by various chemical and physical techniques. The results suggest that the separately injected magnesia acts as a reactive scavenger for the flue gas SO_3 that is generally considered an important factor in coal ash deposits and corrosion.

44286 Investigation of the corrosion performance of boiler, air heater, and gas turbine alloys in fluidized combustion systems. Holder, J.C.; LaNauze, R.D.; Rogers, E.A.; Thurlow, G.G. (National Coal Board, Cheltenham, England). pp 525-535 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The paper reports the behaviour of a range of airheater and turbine materials when subjected to long exposures to the bed environment and combustion gases typical of those proposed for advanced cycle power generation plants using fluidised bed coal combustion. A comparative assessment of the corrosion resistance of materials exposed in the fluidised bed and in the freeboard for two 1000 hour tests is given. Materials exposed to the bed material, which was primarily calcium sulphate, underwent greater attack than materials placed in the freeboard. The austenitic steels generally showed least attack, while the nickel based alloys did not perform well. The programme highlights the need for more detailed information on the micro-environment within the fluidised bed combustor. It would then be possible to determine the effect that operating variables might have on those conditions within the fluidised bed that lead to unacceptable metal loss.

44287 Corrosion of superalloys, inconels, and stainless steels by the products from fluidized-bed coal combustion. Wigton, H.F. (Combustion Power Co., Inc., Menlo Park, CA). pp 537-555 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Metal specimens exposed to the products from the fluidized-bed combustion of high sulfur coal (Illinois No. 6) were examined for evidence of corrosion, particularly alkali-induced sulfidation. The experimental results indicated that temperature level is the single most important factor in determining whether or not sulfidation will occur in a coal combustion system. Below 870°C no evidence of sulfidation was found in turbine blade materials. On the other hand, temperature excursions above 932°C for as little as one hour produced detectable sulfidation in some alloys. Above 954°C catastrophic sulfidation occurred in susceptible alloys. At a temperature of 910°C with clay and magnesium as additives no evidence of sulfidation was found on turbine blade material.

44288 High temperature corrosion in fluidized-bed combustion. Stringer, J. (Electric Power Research Inst., Palo Alto, CA). pp 589-599 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Beause of the low combustion temperature, corrosion of the type observed on superheaters in conventional boilers is unlikely. However, it is shown that within the bed itself, the oxygen and sulfur activities are linked by the $CaO/CaSO_4$ equilibrium, and local low oxygen activities will result in local high sulfur activities. Low oxygen activities (of the order of 10^{-12} atm) have been observed in the bed in one combustor, implying sulfur activities of the order of 10^{-7} atm, sufficient to induce sulfidation of alloy components. Sulfidation/oxidation corrosion of in-bed components has indeed been observed in some cases. It is shown that quite small variations in bed chemistry may move the conditions away from the risk of this form of corrosion. Hot corrosion of turbine components due to the high alkali content of the combustion gases is also considered.

44289 Combustion Institute, central states section spring meeting, 1976. Pittsburgh, PA; Combustion Institute (1976). 507p. (CONF-7604158—).

From Central states section spring meeting; Columbus, OH, USA (5 Apr 1976).

Nineteen papers by various authors are presented. The topics discussed are: combustion of small char/graphite particles, new S.I. engine fuel system, heavy fuels and water-in-fuel emulsions, shale oil, nitric oxide, emissions from coke, shale derived marine diesel fuel, heat transfer of oil/water/air emulsions, pulverized, solvent-refined coal, chemically active fluid bed process, coal use in industrial boilers, diesel fuel marine, methanol fuel, ash in pulverized coal, nitric oxide emissions from coal, coal composition effect of NO/sub x/ production, gas from coal, coal derived liquid fuels in turbine combustors, NO/sub x/ formation from coal nitrogen, and liquid fuel analyses. Individual papers are indexed separately.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 44248

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 44263, 44264

REGULATIONS

REFER ALSO TO CITATION(S) 45002

44290 (NP—23794) **Conservation, cleanliness, and coal.** Stewart, P.J. (General Electric Co., Schenectady, NY (USA). Research and Development Center). Feb 1978. 36p. NTIS.

Studies were made at General Electric on (1) future U.S. energy supply and demand, assuming various national energy policies; (2) the possibility of reducing energy use while allowing economic growth (at an average rate of 3.4%/year, from now to 2000); (3) technical means and costs of minimizing damage to the environment from increased use of coal. According to those studies: (1) since the turn of the century, U.S. energy use per constant dollar of G.N.P. has dropped at a rate of about 1%/yr. During almost all that time real energy prices were dropping as well. That trend will probably continue over the next 25 years, when real energy prices will almost certainly be increasing; (2) the maximum amount that energy requirements for the year 2000 can be reduced by conservation, consistent with 3.4% average annual economic growth, would be 65 quadrillion Btu. U.S. yearly energy consumption would still be almost 50% greater than it is now. The difference will have to be made up largely by coal and nuclear energy; (3) coal production will probably be demand-limited for the next 25 years and the real price will probably not more than double. The cost of transporting low-sulfur coal to distant markets, and of reclaiming strip-mined land should not add more than 10 to 15% to the base cost of the coal. Gasifiers and fluidized-bed burners are developing, and may allow greater use of high-sulfur coal; (4) after the year 2000, we will need more efficient ways of using coal-generated power. Production, at that time, will probably not be able to expand easily to meet increased demand.

PETROLEUM

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 45476

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 45189, 45243

44291 (BETC—0008-2) **Research on surfactant-polymer oil recovery systems. Project status report, September 1—December 31, 1978.** Shah, D.O.; Walker, R.D. Jr. (Florida Univ., Gainesville (USA)). Apr 1979. Contract EW-78-S-19-0008. 131p. Dep. NTIS, PC A07/MF A01.

Progress is reported on studies of: interfacial phenomena, polymer rheology and fluid mechanics, thermodynamic properties, rock/fluid interactions (surfactant/polymer precipitation and adsorption). (DLC)

44292 (BETC—2541-12) **Enhanced oil recovery by improved waterflooding. First annual report.** Edwards, J.B. (Energy Resources Co., Inc., Cambridge, MA (USA)). Oct 1978. Contract EF-77-C-01-2541. 104p. Dep. NTIS, PC A06/MF A01.

Energy Resources Company Inc. (ERCO) is conducting a polymer-improved pilot waterflood in the Storms Pool, near Carmi, in White County, Illinois, in order to demonstrate a successful approach to controlled waterflooding in a previously waterflooded oilfield. The entire field encompassing the pilot area is operated by the Andrews—Haley Oil Company and is typical of a large number of old fields which are candidates for enhanced oil recovery. Once a highly productive field, the Storms Pool has yielded over 12 million barrels of oil. The field has been waterflooded for over 20 years and is now in stripper production. However, field data indicate that there is a substantial volume of movable oil in situ. The polymer flood is designed to improve the sweep efficiency, showing that the engineering, management, and financial resources required for such tertiary oil recovery can be applied to similar oil fields that might otherwise be abandoned.

44293 (FE—2605-20) **Large-scale samples of sulfonates for laboratory studies in tertiary oil recovery preparation and related studies. Final report.** Malmberg, E.W. (Suntech, Inc., Richardson, TX (USA)). Jan 1979. Contract EF-77-C-01-2605. 104p. Dep. NTIS, PC A06/MF A01.

The development and completion of a systematic program of preparation of large-scale laboratory samples of synthetic and petroleum sulfonates is described in the first annual report on this project. The present report describes the second part of this program which includes the study of selected oil recovery parameters, distribution of the samples among interested industrial and academic laboratories, and dissemination of information about the properties of these samples. The basic studies on the oil recovery characteristics of the samples includes determination of optimal salinity, studies on the properties of dispersions with alcohols in brines of different sodium chloride and calcium ion concentration, and measurement of oil recovery from one-foot Berea cores. These experiments have shown some interesting correlations and differences. Samples were requested by thirteen industrial laboratories and fifteen academic/research institute laboratories. The information on the chemical and oil-recovery characterization was sent also.

44294 (SAND—79-1052C) **Investigation of low invasion fluids for pressure coring.** McGuire, P.L.; McFall, A.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 26p. (CONF-790805—6). Dep. NTIS, PC A03/MF A01.

From DOE symposium on enhanced oil and gas recovery and improved drillings technology; Tulsa, OK, USA (22 Aug 1979).

A new pressure coring system is being developed which could significantly improve the measurement of in-situ oil and gas saturations in hydrocarbon reservoirs. This improved system will incorporate a low-invasion fluid that is stored in the core retriever and is extruded to seal and protect the core. The low-invasion fluid consists of an extremely viscous, brine-based polymer stem with sized calcium carbonate bridging particles to minimize invasion. This special coring fluid has been selected from several candidates that were laboratory tested at simulated downhole conditions. Both static and dynamic filtration characteristics were considered. Other important properties of this low-invasion pressure coring fluid are also discussed, including freezing point, formation damage, clay stabilization, wettability changes, and pressure buildup in the core barrel.

44295 (SAND—79-1200C) **DEEP STEAM: development of downhole steam generation systems and injection string modifications for DEEP STEAM injection.** Fox, R.L.; Donaldson, A.B.; Eisenhawer, S.W.; Johnson, D.R.; Krueger, D.A.; Mulac, A.J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 15p. (CONF-790805—5). Dep. NTIS, PC A02/MF A01.

From DOE symposium on enhanced oil and gas recovery and improved drillings technology; Tulsa, OK, USA (22 Aug 1979).

The physical phenomena which limit the depth for economic enhanced recovery of heavy oil by steam injection are: (1) heat loss during delivery, (2) loss of steam quality at the sand face, (3) reduction in specific volume of the vapor phase, (4) change in the two phase enthalpy distribution, and (5) lower reservoir permeability. The application of improved thermal well completions can be successful in reducing heat loss and improving sand face steam quality. Computational analysis and experimental test programs for development of thermal well completion methods are presented. Two designs for downhole steam generation are under development. These designs both use the combustion of hydrocarbon fuel to supply the energy for steam production, but differ in combustion pressure and method of heat transfer. The low pressure combustion generator gives higher energy efficiency. The high pressure generator introduced additional phenomena which can reduce recovery cost and offer improved air quality. Computer modeling of recovery operations have predicted the additional recovery mechanisms contained in the high pressure design more than offset the higher energy efficiency of the low pressure device in many applications. Field operations which test some of the promising aspects of high pressure generator technology as well as problem areas associated with this recovery approach are underway in the Kern River field of California. Progress of the design programs and the field test is reviewed.

44296 **Tannin materials as additives in oil recovery processes involving chemical recovery agents.** Kalfoglou, G. (to Texaco Inc.). US Patent 4,147,214. 3 Apr 1979. Filed date 12 Dec 1977. 8p.

A process for producing petroleum from subterranean formations is disclosed wherein production from the formation is obtained by driving a fluid from an injection well to a production well. The process involves injecting via the injection well into the formation an aqueous solution of tannin as a sacrificial agent to inhibit the deposition of surfactant and/or polymer on the reservoir matrix. The process may best be carried out by injecting the tannin into the formation through the injection well ahead of or mixed with either a polymer, a surfactant solution and/or a micellar dispersion. This mixture would then be followed by a drive fluid such as water to push the chemicals to the production well.

44297 **Enhanced oil recovery process utilizing a plurality of wells.** Sandiford, B.B. (to Union Oil Co. of California). US Patent 4,147,211. 3 Apr 1979. Filed date 30 Nov 1977. 14p.

A process of treating a plurality of wells involved in an enhanced oil recovery process so that oil and/or gas can be displaced from a reservoir in a more uniform manner comprises treating the formation surrounding and in the immediate vicinity of each well involved in the process with a solution that sets with time to form a plug in the more permeable zones of the reservoir surrounding each well.

44298 **Waterflood oil recovery process employing stabilized biopolymers.** Abdo, M.K. (to Mobil Oil Corp.). US Patent 4,141,842. 27 Feb 1979. Filed date 28 Mar 1977. 10p.

A waterflood oil recovery process is described that employs a Xanthomonas polysaccharide as a thickening agent in which the aqueous polysaccharide solution contains a C_3—C_5 aliphatic alcohol. The aliphatic alcohol functions to stabilize the polysaccharide against thermal degradation in reservoirs having temperatures in excess of 60°C. The polysaccharide solution may also contain an alkali metal carbonate which functions with the alcohol to impart further stability to the Xanthomonas polysaccharide solution.

44299 **Oil well spacer fluids.** Watson, J.L. (to Halliburton Co.). US Patent 4,141,843. 27 Feb 1979. Filed date 20 Sep 1976. 18p.

A high stability, nondamaging spacer fluid is provided containing readily available weighting agents such as calcium carbonate and iron carbonate dispersed in water using a polymer viscosifier, a salt inhibitor, a primary sulfonated dispersant and a secondary fatty acid amide dispersion. Conventional high density weighting agents can also be used. The spacer fluid is stable over a temperature range of about 32°—300°F. for extended periods with densities ranging from 11 to 17.6 pounds per gallon.

44300 **Method of recovering hydrocarbons by improving the vertical conformance in heavy oil formations.** Wu, C.H.; Brown, A.; Konopnicki, D.T.; Allen, J.C. (to Texaco Inc.). US Patent 4,141,415. 27 Feb 1979. Filed date 1 Jul 1977. 12p.

A method for recovering viscous hydrocarbons from subterranean formations involves injecting a hydrocarbon solvent into the formation at spaced intervals to produce permeable regions or streaks in the formation. The injection is preferably directed to those regions of highest oil saturation, i.e., those regions with lowest

effective permeability. A subsequent introduction of a heated fluid then will enable recovery of the viscous hydrocarbons in the treated regions and the untreated zones therebetween.

44301 Enhanced oil recovery using alkaline sodium silicate solutions. Holm, L.W. (to Union Oil Co. of California). US Patent 4,141,416. 27 Feb 1979. Filed date 27 Sep 1977. 10p.

An enhanced oil recovery process for subterranean reservoirs wherein there is injected into the reservoir a relatively large slug of a dilute aqueous alkali metal silicate solution. It is optional to follow the silicate solution with an aqueous drive fluid. In treating heterogeneous reservoirs, it is further optional, prior to injecting the large slug of silicate solution, to inject one or more small slugs of the silicate solution alternately with one or more small slugs of a dilute aqueous solution of an agent that reacts with the alkali metal silicate to form a gelatinous precipitate. In the latter instance a small spacer slug of water is injected between successive slugs of the reactant solutions to separate the reactants during injection. It is still another option to precede the injection of the large slug of dilute aqueous alkali metal silicate solution with the injection of a slug of an aqueous solution of an alkali metal or ammonium salt selected from the group consisting of chloride, bromide, iodide and nitrate salts and admixtures thereof.

44302 Method to flood underground, hydro-carbon-containing formations. Rhudy, J.S.; Gogarty, W.B. (to Marathon Oil Co., Findlay, OH (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,430,934/B/. 5 May 1977. 6p. (In German).

In order to increase the yield of a petroleum field, the so-called secondary and tertiary extraction methods are applied. One attempts here to extract the retained petroleum in the sandstone by flooding with an aqueous solution containing a salt-sensitive polymer in order to thus displace the petroleum from the sandstone. Flooding takes place from one borehole to several further boreholes. The patent claims a method in which an aqueous solution of a partly hydrolyzed, high-molecular polyacryl amide is used which serves to reduce the permeability of the formation. In order to counteract this reduction, the total hardness of the water is according to the invention increased by introducing Ca or Mg salts into the polymer solution. Prior to injecting the aqueous polymer solution, a micellar dispersion of the flooding agent should be introduced into the deposit. According to the invention, a polysaccaride may also be used as biopolymer instead of the partly hydrolyzed polyacryl amide.

PROCESSING

REFER ALSO TO CITATION(S) 44617

44303 Selective high conversion cracking process. Chester, A.W.; Schwartz, A.B.; Stover, W.A. (to Mobil Oil Corp.). US Patent 4,137,152. 30 Jan 1979. Filed date 10 Nov 1977. 12p.

A catalytic process is provided for cracking a hydrocarbon charge stock containing aromatic nuclei components and non-aromatic nuclei components which involves contacting such chargestock with a catalyst composition having an alkali metal content less than about 1.5 wt % and containing a mixture of faujasite and mordenite in which contacting takes place under catalytic cracking conditions of such severity that the conversion level exceeds that attributable to conversion of the non-aromatic nuclei portion of the chargestock. Under such conditions, the coke yield is substantially lower than would be obtained with the same catalyst in the absence of mordenite at the same level of conversion.

44304 Demetallization of petroleum feedstocks with zinc chloride and titanium tetrachloride catalysts. Young, D.A. (to Union Oil Co. of California). US Patent 4,148,717. 10 Apr 1979. Filed date 19 Aug 1977. 8p.

Heavy residual fractions are treated to remove vanadium and nickel contaminants by contact with zinc chloride and/or titanium tetrachloride under mild conditions of elevated temperature and pressure. The zinc chloride and titanium tetrachloride act as catalysts for the conversion of vanadium and nickel contaminants to insoluble metal-containing constituents removable by filtration from the product oil. The zinc chloride and titanium tetrachloride are recovered and recycled in the process.

44305 Hydrocarbon conversion with an acidic multimetallic catalytic composite. Antos, G.J. (to UOP Inc.). US Patent 4,148,715. 10 Apr 1979. Filed date 13 Mar 1978. 26p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with an acidic multimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum group component, a lanthanide series component, a nickel component, and a halogen component with a porous carrier material. The platinum group, lanthanide series, nickel, and halogen components are present in the multimetallic catalyst in amounts respectively,, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt. % platinum group metal, about 0.01 to about 5 wt. % lanthanide series metal, about 0.05 to about 5 wt. % nickel, and about 0.1 to about 3.5 wt.% halogen. Moreover, these metallic components are uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum group metal is present therein in the elemental metallic state, substantially all of the catalytically available nickel component is present in the elemental metallic state or in a state which is reducible to the elemental metallic state under hydrocarbon conversion conditions, or in a mixture of these states, while substantially all of the lanthanide series component is present in an oxidation state above that of the elemental metal. A specific example of the type of hydrocarbon conversion process disclosed is a process for the catalytic reforming of a low-octane gasoline fraction wherein the gasoline fraction and a hydrogen stream are contacted with the acidic multimetallic catalyst disclosed herein at reforming conditions.

44306 Control of hydrogen sulfide gas to reduce toxicity and corrosion due to exposures thereto. Tisdale, V.R. (to Sherwin-Williams Co.). US Patent 4,147,212. 3 Apr 1979. Filed date 27 Mar 1978. 4p.

A method is described for the nearly quantitative removal of hydrogen sulfide during the drilling, completing, and working over of oil and gas wells. The carrier of the hydrogen sulfide is intimately contacted with substantially stoichiometric quantities of a water soluble zinc ammonium carbonate complex in aqueous solution.

44307 Process for upgrading arsenic-containing oils. Sullivan, R.F. (to Chevron Research Co.). US Patent 4,141,820. 27 Feb 1979. Filed date 18 Aug 1977. 10p.

A method is provided for avoiding feed-transfer-line plugging by a deposit comprising arsenic in hydroprocessing an oil containing an arsenic contaminant. In the method, a mixture of hydrogen gas and the oil is formed in situ in a bed of porous particulate contact material.

44308 Process for treating a sour petroleum distillate. Carlson, D.H.J. (to UOP Inc.). US Patent 4,141,819. 27 Feb 1979. Filed date 10 Jan 1978. 6p.

A process for treating a mercaptan-containing sour petroleum distillate is disclosed. The process comprises contacting the distillate with a supported metal phthalocyanine catalyst in the presence of an alkaline reagent at oxidation conditions, the catalyst having been prepared by impregnating a solid adsorptive support with a common alcoholic solution of a metal phthalocyanine and a carboxylic acid.

44309 Method fo collecting oil from crude oil residue. An, J.B. US Patent 4,141,818. 27 Feb 1979. Priority date 23 Jun 1977, Korea, Republic of, 4p.

Oil is separated from impurities in crude oil residue by (1) mixing and agitating the oil residue with a solvent, such as naphtha, light oil or kerosene, (2) subjecting the mixture to a centrifugal separator to separate a solvent-oil mixture from the residue impurities. The structure of the centrifugal separator includes a rotating separator unit having a fine mesh wall and located within a heated, spaced cylindrical body.

44310 Hydrocarbon conversion processes utilizing a catalyst comprising a group VIII noble metal component supported on group IIA metal oxide—refractory metal oxide supports. McVicker, G.B.; Garten, R.L. (to Exxon Research and Engineering Co.). US Patent 4,141,817. 27 Feb 1979. Filed date 18 May 1978. 18p.

A novel catalyst which is described comprises a physical mixture of (1) at least one catalytically active transition metal selected from Group VIII of the Periodic Table of the Elements in combination with at least one alkaline earth metal oxide, and (2) an acidic refractory oxide. The combination of one or more of said Group VIII metals and one or more alkaline earth metal oxides may be provided by supporting said metals and said oxides on a nonacidic refractory oxide support. These catalysts are useful in hydrocarbon conversion processes and are characterized as having improved stability under oxidizing conditions, for example, the high temperature oxidation treatments encountered in regenerating deactivated reforming catalysts.

44311 Solvent deasphalting process. Dunmyer, J.C. Jr. (Foster Wheeler Energy Corp). *Energy Process./Can.;* 70: No. 6, 30-32, 34(1978).

Deasphalting petroleum residua with light hydrocarbon solvents has been practised commercially in the refining industry for the past four decades. The process has evolved from a simple asphalt precipitation concept to the present continuous multistage, contercurrent solvent extraction technology to produce deasphalted oil of both high yield and quality. Two basic concepts commonly em-

ployed--the mechanically agitated unit and the static element or baffle design--are described, and recovering the solvent from a deasphalting operation is discussed in detail.

PRODUCTS AND BY-PRODUCTS

44312 (DOE/TIC—10818) **Proposed gasoline and diesel fuel rationing contingency plan. Economic impact analysis.** (Federal Energy Administration, Washington, DC (USA)). Apr 1977. 309p. Dep. NTIS, PC A14/MF A01.

Title II of the 1975 Energy Policy and Conservation Act (PL 94-163) requires the development of fuel-contingency plans to meet any future oil embargo. Among other requirements, the Act mandated the Federal Energy Administration to: (1) establish a standby program for the rationing and ordering of priorities among classes of end users of gasoline and diesel fuel used in motor vehicles, and (2) assess, to the extent practicable, the economic impacts of the proposed FEA rationing plan. This report analyzes the various impacts of the proposed plan on the national economy, vital industrial sectors, states and regions, and competitive conditions based on the following scenario: (a) the baseline for the economic impact assessment is the projected economy in 1977 operating under an embargo causing a 12% reduction in available petroleum products; (b) based on small changes in refinery mix, shortages of 17% for motor gasoline and 8% for diesel fuel are experienced; (c) the mandatory allocation program is in full operation; (d) the embargo begins in the fourth quarter, 1976; and (e) rationing begins early in the first quarter of 1977 and extends through the second quarter of 1978.

44313 **Catalytic refining process for tank bottoms wax.** Holder, C.H. (to Exxon Research and Engineering Co.). US Patent 4,148,711. 10 Apr 1979. Filed date 5 Jul 1977. 10p.

High melting, deoiled and mildly deasphalted tank bottoms wax is catalytically refined in two stages using a catalyst comprising nickel molybdate on alumina. The first stage is maintained at a temperature at least about 50°F higher than the second stage, and the temperature in the second stage is allowed to go no higher than about 575°F. Hydrofined wax product from the second stage is recycled back into same and the temperature in the first stage is periodically increased in order to counteract deactivation of the catalyst. By using a judicious combination of process conditions, unrefined high melting tank bottoms microwax stocks can be made into high quality, high melting point microwax having excellent color and meeting FDA purity requirements.

44314 **Synthetic aircraft turbine oil.** Yaffe, R. (to Texaco Inc.). US Patent 4,141,844. 27 Feb 1979. Filed date 28 Jun 1977. 6p.

A pentaerythritol ester base lubricating oil composition with improved oxidation stability for a gas turbine engine is described. The major portion of the oil is formed from the reaction of pentaerythritol and an organic monocarboxylic acid and contains an alkylphenyl or alkarylphenyl naphthylamine, a dialkyldiphenylamine, a polyhydroxy anthraquinone, a hydrocarbyl phosphate ester and an S-alkyl-2-mercaptobenzimidazole.

44315 **Synthetic aircraft turbine oil.** Yaffe, R. (to Texaco Inc.). US Patent 4,141,845. 27 Feb 1979. Filed date 28 Jun 1977. 6p.

A pentaerythritol ester base lubricating oil composition for a gas turbine engine is described. The major portion of the oil is formed from the reaction of pentaerythritol and an organic monocarboxylic acid and contains an alkylphenyl or alkarylphenyl naphthylamine, a dialkyldiphenylamine, a polyhydroxy anthraquinone, a hydrocarbyl phosphate ester and an S-alkyl-2-mercaptobenzothiazole.

44316 **Lubricant additive.** Jayne, G.J.J.; Askew, H.F. (to Edwin Cooper and Co., Ltd.). US Patent 4,141,846. 27 Feb 1979. Priority date 26 Mar 1976, United Kingdom of Great Britain and Northern Ireland (UK), 14p.

New compounds are derived from intramolecular and intermolecular, in the case of a polymer, sulfur-bridged hydrocarbon rings containing from 6 to 12 carbon atoms. The hydrocarbon ring is preferably derived from 1,5-cyclooctadiene. The compounds also contain the residue of an alkoxyalkyl or aryloxyalkyl xanthate and may also contain the residue of a further nucleophilic group. The new compounds are useful in lubricating oil compositions. The compositions may also contain other conventional lubricant additives.

MARKETING AND ECONOMICS

44317 (PB—286683) **Marine bunker fuels - analysis and forecast of price and availability. Final report.** (Mortada International, Dallas, TX (USA)). Oct 1978. Contract MA-7-38015. 148p. NTIS PC A07/MF A01.

This study develops forecasts through 1993 of the refiner's acquisition costs for crude oil from domestic sources and for crude oil imports. Domestic crude oil price and availability are analyzed by producing region, taking into account the effects of energy legislation on domestic crude oil prices. The level of imports is based on U.S. energy requirements and the supply of energy from domestic sources. The prices of Marine Bunker Fuels are forecast based on the refiner's acquisition costs of crude oil and the processing and desulfurization costs. The effects of the rising ratio of high to low sulfur crude oil on the availability of Marine Bunker Fuels are analyzed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 45390, 45458, 45460

44318 **Conference on assessment of ecological impacts of oil spills.** Arlington, VA; American Institute of Biological Sciences (1978). 944p. (CONF-780661—).

From Ecological impact of oil spills; Keystone, CO, USA (14 Jun 1978).

Forty one papers presented at this conference covered the following subjects: socio-economic legal aspects of oil spills, impact of spills on wildlife and benthic organisms, effect of spills in extreme climatic zones, impact of Ekofisk Bravo Blowout, impact of the NEPCO No. 140 Barge Spill, the Argo Merchant Spill, the Buchard No. 65 Barge Spill and other pertinent oil spills. Individual papers were abstracted separately for the data base.

44319 (PB—284566) **Alaska OCS socioeconomic studies program. Beaufort Sea region sociocultural systems. Technical report.** (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Worl Associates, Anchorage, AK (USA)). Jun 1978. Contract DI-AA550-CT6-61. 176p. NTIS PC A09/MF A01.

The objective of the following report is to promote an understanding of the sociocultural dynamics of the Beaufort Sea Petroleum Development Region. The report attempts to demonstrate that the social, cultural, and psychological values are as important as the economic values of the environment to the regional population.

44320 (PB—284567) **Alaska OCS socioeconomic studies program. Beaufort Sea region natural physical and biotic baseline. Final report.** (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). May 1978. Contract DI-AA550-CT6-61. 48p. NTIS PC A03/MF A01.

The purpose of this study is to provide critical natural physical information in mapped and narrative form for the Beaufort Sea Region. The information will be used to form the basis for the projection of natural physical environmental impacts and resource conflicts. To assess the socioeconomic impacts of Beaufort Sea OCS petroleum development, an environmental baseline has to be established. Included in such a baseline are those aspects of the natural physical and biotic environment that may be related indirectly or directly to the economic and cultural infrastructure of the resident population.

44321 (PB—284568) **Alaska OCS socioeconomic studies program. Anchorage socioeconomic and physical baseline. Final report.** Ender, R.L.; Gehler, J.; Gorski, S.; Harper, S. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Ender (Richard L.), Anchorage, AK (USA)). Jun 1978. Contract DI-AA550-CT6-61. 293p. NTIS PC A13/MF A01.

The document is a community profile on the Municipality of Anchorage encompassing socio-economic and physical data. Topics include a brief history of the inception of Anchorage as a township with an overview of significant historical events; a comprehensive discussion of the Anchorage economy and current demographic information; local government revenues and expenditures; community support service sectors including health services, social services, leisure and recreational services, education, police (state and local), fire, and emergency medical services; physical characteristics of Anchorage; utilities; and transportation. Within each section, where applicable, current issues are identified and planning efforts designed to alleviate problem areas are discussed. (Portions of this document are not fully legible)

44322 (PB—284569) **Alaska OCS socioeconomic studies program. Anchorage socioeconomic and physical baseline. executive summary. Technical report.** Ender, R.L.; Gehler, J.; Gorski, S.; Harper, S. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Ender (Richard L.), Anchorage, AK (USA)). Jun 1978. Contract DI-AA550-CT6-61. 39p. NTIS PC A03/MF A01.

The purpose of the report is to examine baseline information on Anchorage designed to assess the corresponding impact of four petroleum developments proposed for the Beaufort Sea region. The baseline report is a community profile which examines historical

trends and current data, identifies key issues within specified sectors of the community, and, where possible, explores planning processes designed to respond to pressing issues. Through the use of key indicators such as economic trends, manpower requirements, land use planning, social services, and physical characteristics, impact of future growth in Anchorage and of proposed development in the Beaufort Sea region can be assessed.

44323 (PB—284570) **Alaska OCS socioeconomic studies program. subtask 5-b, Alyeska-Fairbanks case study. Technical report.** (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Wordsmiths, Fairbanks, AK (USA)). 8 May 1978. Contract DI-AA550-CT6-61. 129p. NTIS PC A07/MF A01.

Fairbanks, Alaska was the only urban community in the construction corridor of the trans-Alaska oil pipeline. The community was faced with planning and decision making to prepare for the impact of the pipeline, but had to do much of the planning without information. Population growth, stress on the Fairbanks infrastructure, social problems and the continuation of the economic cycles of boom and bust are examined through three major impact research works completed during and just after pipeline impact. Synthesis of this information details what the community of Fairbanks learned from the impact of pipeline construction, the attitudes of residents toward future growth and development and how they are applying the lessons of oil pipeline impact to planning and decision making for the future of the community.

44324 (PB—284571) **Alaska OCS socioeconomic studies program. Beaufort Sea petroleum development scenarios: natural physical environment impacts. Final report.** (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Jun 1978. Contract DI-AA550-CT6-61. 108p. NTIS PC A06/MF A01.

The report analyzes the environmental impacts of Beaufort Sea petroleum exploration, development and production. Petroleum development scenarios have been established which provide a reasonable range of technological, economic and geographic options for minimum and maximum impact data. Using the petroleum scenarios, man's impact on the North Slope of Alaska is analyzed for two situations. First, the impacts of man if OCS development does not occur and secondly, if OCS development does occur. The discussions concern water resources, water quality, sanitation, mineral resources (mainly sand and gravel) and fish and wildlife resources.

44325 (PB—287754) **Boom configuration tests for calm-water, medium-current oil spill diversion. Final report.** Breslin, M.K. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Aug 1978. Contract EPA-68-03-0490. 49p. NTIS PC A03/MF A01.

The purpose of this test program was to determine the effects of boom angle, length, and rigging configuration on diversion of oil floating on moving streams. The B.F. Goodrich Seaboom was chosen for the program because of its availability, durability, and stability. It was rigged in different diversionary modes and towed into an oil slick at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) facility at various speeds, until critical stability speed was attained. Boom performance was recorded on photographs, video tapes, and observer notes. Results were evaluated in terms of the percentage of oil lost beneath the boom and away from the rear of the boom. A 'nozzle-shaped' boom configuration achieved the best diversion at tow speeds examined above 1.0 m/s. Different exits from the nozzle configuration were investigated to find which one released the oil with the least amount of entrainment and spreading. A straight exit with tapered ends worked best. Tests were conducted in accordance with a test matrix developed by the U.S. Environmental Protection Agency.

44326 (PB—287822) **Performance testing of the tetradyne high speed air jet skimmer. Final report 13 May 76.** McCracken, W.E.; Schwartz, S.H. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Aug 1978. Contract EPA-68-03-0490. 45p. NTIS PC A03/MF A01.

The U.S. Environmental Protection Agency evaluated the performance of the prototype Tetradyne High Speed Air Jet Skimmer at their OHMSETT test facility at Leonardo, New Jersey. The skimmer depends on an air-jet impacting the water surface at an angle and deflecting rapidly moving, floating, spilled material laterally into a low-current chamber for ease in recovery. The objective of the testing program was to determine the ability of the Tetradyne skimmer to pick up a large area, thin film (0.1-1.0 mm) spill of floating oil in water currents up to 3 m/s. The four test fluids used during the program, No. 2 fuel oil, naphtha, and two lubricating stocks, encompassed a wide range of physical properties. The recovery performance parameters determined were recovery rate and throughput efficiency. The effects of film thickness, fluid viscosity, fluid specific gravity, and fluid interfacial tension on skimmer performance parameters under fast current conditions are presented. Modifications for futher improving performance are recommended.

44327 **Chemical dispersants for the control of oil spills.** McCarthy, L.T. Jr.; Lindblom, G.P.; Walter, H.F. (eds.). Philadelphia, PA; American Society for Testing and Materials (1978). 315p. (CONF-771097—). $30.00.

From Symposium on spill control systems; Williamsburg, VA, USA (4 Oct 1977).

Twenty two papers are presented on cleaning oil spills using chemical dispersants. Separate abstracts were prepared for each paper.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 44266

PROPERTIES

REFER ALSO TO CITATION(S) 44236

44328 **Hydrocarbon-containing preparation.** Aaron, C.; Edwards, A.H.; Tessier, K.C. (to Exxon Research and Engineering Co., Elizabeth, NJ (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 1,811,576/B/. 27 Oct 1977. 7p. (In German).

The invention deals with the pour-point depression of shale oil and crude oil by adding an oil-soluble copolymerisate in quantities of 0.0001 to 10wt.% and an average molecular weight of over 1000. The crude oil may be a paraffin or wax crude oil whose upper pour-point is usually above -23°C. One adds a copolymerisate of ethylene to an ethylenic unsaturated ester, ether, styrene, α-olefin or halide with one or several saturated linear side-chains with at least 18 carbon atoms, as well as to an ethylenic unsaturated acid or salt, ester, amide or imide, anhydride or hydroxy compound or nitrile, having no saturated linear side-chains with more than 17 carbon atoms. The copolymerisate simplifies the transport of crude oil through pipelines, it may also though be introduced into boreholes or oil layers of crude oil to prevent the formation of paraffin deposits or to dissolve up existing deposits on the pipe cladding.

44329 **Tagged fuel compositions.** Keller, J.L. (to Union Oil Company of California). US Patent 4,141,692. 27 Feb 1979. Filed date 19 Jan 1977. 6p.

Liquid fuels of readily identifiable origin contain extremely small quantities of certain types of chlorohydrocarbon or chlorocarbon tracers dissolved therein. The presence of such tracers is readily detected by gas chromatography, using a pulsed electron capture detector.

COMBUSTION

REFER ALSO TO CITATION(S) 44268, 44289

44330 **Investigation of acid smut formation in an industrial boiler plant.** Hedley, A.B.; Papavergos, P. (Univ. of Sheffield, England). pp 113-127 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

A boiler plant over forty years old consisting of five water tube boilers originally coal fired but converted to residual fuel oil firing in 1972 subsequently started emitting acidic carbonaceous smuts from the chimney stack. This problem was investigated experimentally by flue gas sampling for sulphur oxides and particulate solids at different points in the system and relating the results to operating conditions. It was concluded that acid smut particles could be formed by interaction of sulphur oxides and smoke particles within the flue gases at temperatures higher than the sulphuric acid dewpoint. The distribution of smut fallout in the neighbourhood of the chimney stack was also reported.

44331 **Deposition of inorganic material in oil-fired boilers.** Jackson, P.J. (Central Electricity Generating Board, Southampton, England). pp 147-161 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

An experimental study has been made of deposit formation in superheaters of residual oil-fired boilers. Using a portable air-cooled probe, the mass transfer rates of ash constituents and magnesium compounds derived from anticorrosion fuel additives on to surfaces at 510 to 730°C were determined. Data are presented showing the

rates of deposition and the composition of the deposited material. Comparison with the long-term accumulations of deposits indicates the vapour diffusion inwards of sodium compounds and the in-situ sulphation of deposited magnesium oxide. It appeared that the deposition of magnesium compounds enhanced the deposition of sodium sulphate. Much higher deposition rates of ash constitutents were measured on probe surfaces below the acid dew point.

44332 Characterization of corrosion and deposits in the laboratory gas turbine simulator burning heavy fuels with additives. Lee, S.Y.; Spengler, C.J. (Westinghouse R & D Center, Pittsburgh, PA). pp 285-308 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Gas turbine oil soluble additives were evaluated at various turbine blade metal temperatures in a laboratory gas turbine simulator burning fuels which contain potentially corrosive trace elements. Deposits that form when using magnesium and silicon based additives consist of spherical particles of MgO and cristobalite cemented together by magnesium orthovanadate and magnesium orthophosphate. In the additive testing, the fuel used always contained trace amounts of Na, Ba, P, K (usually less than 1 ppM) in addition to vanadium. For a high vanadium test (~ 100 ppM V) the small amount of these elements did not influence the performance of additives. But for a low vanadium test (<10 ppM V), these trace elements were found to influence the effectiveness of additives significantly. Electron microprobe analysis scanning near the metal surface indicated that Na, Ba, etc., will segregate within the deposit and tend to concentrate near the deposit and scale interface where they can melt and cause hot corrosion of superalloys. The molten material was found to be a mixture of Na_2SO_4, $BaSO_4$, and Ni_2SiO_4 some of which will melt below 927°C. It is also possible that these compounds will form an eutectic mixture. It is concluded that trace elements other than vanadium in the fuel form significant phases when there is a low additive to trace element ratio and that segregation and reaction with oxide scales by certain elements produces localized regions of accelerated attack.

44333 Part I: formation and removal of residual fuel ash deposits in gas turbines formed at firing temperatures below 982°C (1800°F). Urbas, T.A.; Tomlinson, L.H. (General Electric Co., Schenectady, NY). pp 309-320 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

A series of combustion tests, nominally of 100 hours duration each, burning treated Bunker C fuel and synthetic Bunker C fuel were conducted in a simulated gas turbine combustor with a first stage nozzle vane segment. These tests have demonstrated that nozzle plugging rates, also called ash deposit rates, increase both as the firing temperature and sodium content in the fuel increase. Ash deposits result in a decrease in the effective area of the nozzle and, therefore, a similar reduction in power output. It has been shown that Ca in the fuel greatly enhances the deposit rate and also forms hard deposits. Ash deposit chemistry is highly temperature dependent. At a pressure of 5 atmospheres and with 1 to 2 wt % S in the fuel, the deposit changes from soft (primarily $MgSO_4$) to hard (primarily MgO) in the temperature range of 927°C (1700°F) to 982°C (1800°F). Nutshells and thermal shock are effective on a variety of soft ash deposits formed at firing temperatures of 982°C (1800°F) and below, removing 20 to 90% of the deposits. A synthetic Bunker C composed of an aqueous additive solution uniformly dispersed in a No. 2 fuel oil was shown to be feasible because both ash deposit rates and the chemical and physical nature of deposits formed were the same as those from real Bunker C fuels.

44334 Part II: formation and removal of residual fuel ash deposits in gas turbines formed at firing temperatures above 982°C (1800°F). Urbas, T.A.; Tomlinson, L.H. (General Electric Co., Schenectady, NY). pp 321-333 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Ash deposition tests using synthetic Bunker C fuels (composed of an aqueous additive solution uniformly dispersed in a No. 2 fuel oil) were conducted in a simulated gas turbine combustor with a first stage nozzle vane segment. Silicon, when used in a ratio of Si/Mg/V of 7:3:1 in the fuel, has been shown to reduce nozzle plugging rates (ash deposit rates) by an order of magnitude with a fuel containing 2 to 10 μg/ml Na; use of less silicon results in a smaller reduction in deposit rates. An MgO slurry has the advantages of being less expensive than an oil soluble type and has much less bulk than epsom salt solutions. However, it has relatively much larger particles than those from oil soluble inhibitors or epsom salt solution, but was still shown to be an effective vanadium inhibitor. A combination of washing and soaking for one half hour at a cold water flow rate of 0.14 dm^3/sec per kg/sec airflow (one gpm/one lb air per sec airflow) per combustion chamber followed by a refire to 538°C (1000°F) has been shown to be an effective means of removing hard ash deposits formed at 1066°C (1950°F) firing temperature.

44335 Water/oil emulsion combustion in boilers and gas turbines. Zwillenberg, M.L.; Sengupta, C.; Guerra, C.R. (Public Service Electric and Gas Co., Newark, NJ). pp 335-355 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The use of water-in-oil emulsions (wherein each fuel droplet leaving the atomizer contains a dispersion of microdroplets of water) is a promising technique which has been proposed for the reduction of smoke and NO/sub x/ emissions from boilers and gas turbines. This technique appears also beneficial in preventing gas turbine blade fouling from the deposition of fuel additives and residues from fuel combustion. An evaluation of the efects of water/fuel emulsions if used in utility steam boiler and gas turbine operation has been performed to assess their relative importance. Factors considered include unit efficiency and operational factors, corrosion and deposits, environmental effects and costs. A planned experimental study of water/fuel emulsion combustion in a 25 MWe PSE and G gas turbine/generator unit is outlined. This study includes emulsion characterization, monitoring of particulates, opacity, NO/sub x/, CO and hydrocarbons and hot-end turbine inspection to detect corrosion effects.

44336 Technical evaluation of magnesia's influence on fireside deposits, combustion, and emissions on oil-fired boilers. Blauenstein, E. (Pentol GmbH, Weil a/Rhein, Germany). pp 359-368 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

In Europe the use of high sulfur, low quality fuels causes major combustion and environmental problems. A controlled application of suspended magnesia in a Belgian 300 MW boiler clearly demonstrates that overall boiler operation is significantly improved. New methods of liquid suspension injection enable short- and long-term improvements in combustion and thermal balance. Environmental highlights of the test: unburned carbons reduced 80%, acid smut fallout eliminated, and particulate emissions greatly reduced.

NATURAL GAS

RESERVES

REFER ALSO TO CITATION(S) 44687

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 45476

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 44299, 44306

44337 (ORO—5197-11) **Study of hydrocarbon—shale interaction. Progress report 11, October 1—December 31, 1978.** Schettler, P.D. Jr.; Wampler, D.L. (Junista Coll., Huntingdon, PA (USA)). 1979. Contract EY-76-S-05-5197. 65p. Dep. NTIS, PC A04/MF A01.

Work was directed at collecting data, building the high pressure isotherm-degasibility apparatus, and modifying the earlier diffusion model for well production to include explicitly the effect of fracture resistance. Four tasks are reported on: high pressure, low pressure data, productivity calculations, and interpretation in terms of other laboratory data. Some of the data are included in this volume, with the remainder appearing in Parts 2 to 5. (DLC)

44338 (ORO—5197-11(Pt.2)) **Study of hydrocarbon—shale interaction. Progress report 11. Part II. Appendix B (continued).** (Junista Coll., Huntingdon, PA (USA)). 1979. Contract EY-76-S-05-5197. 59p. Dep. NTIS, PC A04/MF A01.

This volume contains pages B61 through B120 of the data summary on shale degasibility. (DLC)

44339 (ORO—5197-11(Pt.3)) **Study of hydrocarbon—shale interaction. Progress report 11. Part III. Appendix B (continued).** (Juniata Coll., Huntingdon, PA (USA)). 1979. Contract EY-76-S-05-5197. 60p. Dep. NTIS, PC A04/MF A01.

This volume contains pages B121 through B180 of the data summary on shale degasibility. (DLC)

44340 (ORO—5197-11(Pt.4)) **Study of hydrocarbon—shale interaction. Progress report 11. Part IV. Appendix B (continued), Appendix C.** (Juniata Coll., Huntingdon, PA (USA)). 1979. Contract EY-76-S-05-5197. 66p. Dep. NTIS, PC A04/MF A01.

This volume contains pages B181 through B226 of the data summary on shale degassing, and a two-step model for gas production from low-permeability shales. The model accounts explicitly for both flow of methane through fractures and diffusion through bulk shale to the fractures. Fracture lengths are calculated which are in the order of several kilometers. A single such fracture 0.1 mm wide and intersecting a 40-m length of well bore can account for 50 Mcf/d after 1 year using a specific degasibility of the rock of 4 x 10^{-7} $cm^3/cm^3/torr/s/sup\ 1/2/$.

44341 (ORO—5197-11(Pt.5)) **Study of hydrocarbon—shale interaction. Progress report 11. Part V. Appendix D, Appendix E, Appendix F.** (Juniata Coll., Huntingdon, PA (USA)). 1979. Contract EY-76-S-05-5197. 55p. Dep. NTIS, PC A04/MF A01.

The three appendices are: correlation of specific degasibilities and isotherm measurements with other data; gas chromatographic analysis of off-gassing from wells WV6-MERC-IX, IL3-EGSP, WV5-EGSP, IN2-EGSP, NY1-EGSP, and WV7-EGSP; and report on effect of water and air on specific degasibilities and isotherm parameters.

44342 (ORO—5197-13) **Study of hydrocarbon—shale interaction. Progress report 13, January 1—March 31, 1979.** Schettler, P.D. Jr.; Wampler, D.L. (Juniata Coll., Huntingdon, PA (USA)). 1979. Contract EY-76-S-05-5197. 189p. Dep. NTIS, PC A09/MF A01.

Work was effected on all four tasks (high pressure, low pressure data, productivity calculations, interpretation in terms of laboratory data). A correlation was noted between the ^{238}U content of shale samples and specific degasibility. A generalization of all our productivity modeling to date (taking into account fracture and diffusive flow) indicates that flat production curves can be associated with a variety of constrictive effects in the fracture system at or near the well bore. (DLC)

MARKETING AND ECONOMICS

44343 (PB—284350) **Indiana natural gas: accommodation to reality.** (Indiana Lt. Governor's Science Advisory Committee, Indianapolis (USA)). 1 Feb 1976. 33p. NTIS PC A03/MF A01.

This report focuses on the questions of the most likely pattern of natural gas curtailments across Indiana in the near future, and whether alternative energy sources can realistically replace projected shortages in the short- and mid-term. Findings and policy options are discussed, as are the Indiana natural gas supply and demand situation and energy alternatives.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 44257

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 44294

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 44343

TRANSPORT, PIPELINES, AND HANDLING

44344 (DOE/TIC—10361) **Risk assessment of alternative Alaskan natural gas transportation systems. Final report.** (Resource Planning Associates, Inc., Cambridge, MA (USA)). 30 Jun 1977. 123p. Dep. NTIS, PC A06/MF A01.

Three competing applications to construct a system for transporting Prudhoe Bay natural gas to the Lower 48 states in the U.S. have been filed with FPC: Arctic Gas Group, El Paso, and Alcan. This document reports a study of the project-completion risk of each of the proposed projects, i.e., the risk that a specific project could not be constructed within its proposed schedule and budget. The potential risk impacts on schedule and cost were evaluated over a broad range of probability, ranging from high to low probability. The four major activities that will have to be conducted were analyzed: preconstruction activities, eqipment procurement, logistics, and construction. The overall conclusion is made that it is highly probable that none of the proposed projects would be able to meet its schedule for delivering gas to the contiguous U.S., and that each project would probably experience some direct-cost overrun. The FPC cost-of-service models were used to estimate the changes in cost-of-service from those projected by the applicants. (DLC)

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 45099

DRILLING, FRACTURING, AND MINING

44345 (SAND—77-1501) **Calculations of borehole springing in oil shale (Rock Springs Site 6A).** Kipp, M.E. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 41p. Dep. NTIS, PC A03/MF A01.

Explosive loading of a borehole has been considered as a means for preparing an oil shale bed for in situ retorting. Calculations of the oil shale response to a detonating column of explosive demonstrate that a significant region of the surrounding material experiences sufficient tensile stress to cause fracturing. A subsequent detonation in a prefractured region is shown to result in a negligible increase in fractured shale. Important requirements for future fracture are discussed.

44346 (SAND—78-1885) **Instrumentation and evaluation of the Talley Energy Systems, Inc. oil shale project. Part I. Hydraulic fracture results.** Beasley, R.R. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 143p. Dep. NTIS, PC A07/MF A01.

This is the first of two reports which describe the instrumentation and measurement techniques employed and present the data obtained during Phase I operations on the Talley Energy Systems, Inc., oil shale field project near Green River, Wyoming. Phase I operations included creation of four horizontal hydraulic fractures in the oil shale formation from a central wellbore drilled and cased through the formation and notched at each hydrofrac level, about seven feet apart. Asymmetry was relatively consistent, but direction of asymmetry was not as expected prior to hydrofrac operations. The methods of determining hydrofrac sizes correlated well with degree of asymmetry, but surface resistivity measurements beyond the first fracture did not work well because the first fracture retained conductive fluid and masked the growth of the subsequent fractures. Raw, processed, and interpreted data and the Site Activities Summary Log are presented in appendices.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 45134

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 44300, 44337, 44338, 44339, 44340, 44341, 44342, 44345, 44346

44347 (PB—284267) **Hydrologic analysis of the U.S. bureau of Mines' underground oil-shale research-facility site, Piceance Creek basin, rio blanco county, colorado. Final report.** Dale, R.H.; Weeks, J.B. (Geological Survey, Lakewood, CO (USA). Water Resources Div.; Bureau of Mines, Washington, DC (USA)). May 1978. 40p. NTIS PC A03/MF A01.

The U.S. Bureau of Mines plans to develop an underground oil-shale research facility near the center of Piceance Creek basin. The oil-shale zone, which is to be penetrated by a shaft, is overlain by 1,400 feet of sedimentary rocks, primarily sandstone and marlstone, consisting of two aquifers separated by a confining layer. Three test holes were drilled by the U.S. Bureau of Mines to obtain samples of the oil shale, and to test the hydraulic properties of the two aquifers. The data collected during construction of the test holes

were used to update an existing ground-water-flow computer model. The model was used to estimate the maximum amount of water that would have to be pumped to dewater the shaft during its construction. Based on the model, it is estimated that it would be necessary to pump as much as 3,080 gallons per minute to keep the shaft dry. Disposal of waste water and rock are the principal hydrologic problems associated with constructing the shaft.

44348 (SAND—78-2367C) **Overview of in situ oil shale technology and recent advances in true in situ retort modeling.** Tyner, C.E. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790803—08). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Portions of document are illegible.

In view of current liquid fuel shortages, development of the oil shale resources of Colorado, Utah, and Wyoming, estimated to contain more than one trillion barrels of oil equivalent, must be considered. The in situ processing of this resource offers a potentially attractive alternative, both economically and environmentally, to surface processing. True and modified in situ retorting technologies are described and current research in these areas briefly outlined. True in situ and related low-void in situ processes would minimize the mining and materials handling problems associated with other technologies. A comprehensive mathematical model has been developed to describe the retorting process in these beds. Use of the model to investigate the effect of various retort geometries and bed conditions on the oil yield from true in situ and low-void in situ retorts is discussed.

44349 (UCRL—82086) **Studies of ignition of in situ oil-shale retorts with hot inert gas.** Carley, J.F.; Braun, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 21p. (CONF-790803—30). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Preheating with hot, inert gas appears to be a promising method to prepare modified-in-situ oil-shale retorts for ignition. Computer simulation was used to determine the effects of four factors on preheating time, on retorting rate and peak temperatures reached after changeover, and the bank of char generated in the topmost layers of the rubble. The factors are: grade of shale, void fraction of rubble, particle size, and composition of retort gas (percent of air in air/steam mixture). Maximum gas temperature rose sharply with grade and percent air, weakly with particle size; char bank rose with grade and volume fraction of solids, as expected; retorting rate rose most strongly with percent air and void fraction, while preheating time decreased with increasing void fraction and grade. Simple empirical equations provide excellent fits to the results of the complex model calculations over the practical range of the factors.

44350 Pressure-balanced oil recovery process for water productive oil shale. Laumbach, D.D.; Koci, P.F. (to Shell Oil Co.). US Patent 4,148,359. 10 Apr 1979. Filed date 30 Jan 1978. 8p.

In producing shale oil from a water-productive leached zone of a subterranean oil shale the reservoir pressure is counterbalanced to restrict water production. A generally vertical heated channel is formed by injecting steam into a lower location while producing fluid from an upper location until a steam zone extends substantially between the locations. Oil shale is pyrolyzed within the heated channel by flowing gaseous fluid, which contains noncondensable components and is heated to an oil shale pyrolyzing temperature, upward through the channel. Shale oil is recovered from the fluid flowing upward through the channel while the composition, pressure and rate of flow of that fluid are adjusted to maintain a selected ratio between its oil phase and aqueous phase components.

44351 Combustion air injection well. Hollingsworth, F.H. (to Standard Oil Co. (Indiana)). US Patent 4,147,213. 3 Apr 1979. Filed date 22 Feb 1978. 6p.

A combustion air injection well completion comprises an outer casing having a reduced diameter lower portion and a small diameter liner casing which is run inside the outer casing and screwed into the upper end of the small diameter portion of the outer casing. The resulting completion provides an annular conduit through which cooling or divertent fluid may be injected into formations while combustion air is simultaneously pumped through the inner casing and into formations through perforations in the small diameter portion of the outer casing.

SURFACE METHODS

REFER ALSO TO CITATION(S) 44249

44352 Fluidized bed process for retorting oil shale. Burton, R.S. III. (to Occidental Oil Shale, Inc.). US Patent 4,148,710. 10 Apr 1979. Filed date 13 Jun 1977. 8p.

Oil shale is pyrolyzed by introducing an oil shale feed to a retorting zone fluidized bed to yeild, as products of retorting, retorted oil shale containing residual carbonaceous material and volatilized hydrocarbons. The retorted oil shale particles are passed to the top of a combustion zone fluidized bed into which a gaseous source of oxygen is introduced for fluidizing the combustion zone fluidized bed and oxidizing residual carbonaceous material contained in the retorted oil shale particles to yield combustion gases for fluidizing the retorting zone fluidized bed and for maintaining the retorting zone fluidized bed at a temperature sufficient to retort oil shale.

REFINING

REFER ALSO TO CITATION(S) 44303, 44305

44353 (FE—2315-25) **Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. First interim report, processing of Paraho shale oil.** Sullivan, R.F.; Stangeland, B.E.; Rudy, C.E.; Green, D.C.; Frumkin, H.A. (Chevron Research Co., Richmond, CA (USA)). Apr 1978. Contract EX-76-C-01-2315. 228p. Dep. NTIS, PC A11/MF A01.

Advanced commercial petroleum processing technology was employed in pilot plant facilities to produce transportation fuels (gasoline, kerosene, jet fuel, and diesel) from Paraho shale oil. Three likely refining routes were identified and demonstrated sufficiently to permit preparation of screening-type process designs and cost estimates: (1) hydrotreating followed by hydrocracking, (2) hydrotreating followed by catalytic cracking, and (3) coking followed by hydrotreating. In a fourth feasible alternative, raw shale oil was hydrotreated to produce a synthetic crude suitable for processing in an existing refinery. The key to successful shale oil refining is an effective initial hydrotreating step. This removes contaminants and permits the use of conventional hydrocracking or fluid catalytic cracking. Distillates from coking of raw shale oil also require subsequent hydrotreating to remove residual impurities and meet final product specifications. Refining costs to convert raw shale oil to transportation fuels were estimated to be about $8 to $10/barrel, depending upon the processing route and based on producing 100,000 BPCD of transportation fuels from a grass roots refinery located near a Rocky Mountain or Mid-Continent urban center. Costs are higher for smaller, remotely located refineries. Hydroprocessing of raw shale oil to produce a synthetic crude would cost about $6.50/barrel.

PURIFICATION

REFER ALSO TO CITATION(S) 44307

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 44236, 44289, 44328

44354 (CONF-790503—4) **Three-dimensional characterization of the mechanical properties of Green River formation oil shale of Wyoming's Tipton Member.** Chong, K.P. (Univ. of Wyoming, Laramie); Costello, K.L.; Smith, J.W. (Wyoming Univ., Laramie (USA); Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). 1979. Contract EF-77-S-04-3954. 24p. Dep. NTIS, PC A02/MF A01.

From Spring meeting of society for experimental stress analysis; San Francisco, CA, USA (20 May 1979).

The twelve non-zero coefficients in the stiffness and flexibility matrices for Ticton Member oil shale are expressed in terms of the elastic nonlinear constants consisting of Young's moduli and Poisson's ratios obtained from uniaxial compression tests on square prisms taken from the same horizon of 6-inch core. These matrices relate the three-dimensional stresses and strains, from which data such as pressure versus volume changes can be derived. Pertinent independent variables on the elastic constants include organic volume and stress levels. Physical model and regression analyses are developed for these elastic constants.

MARKETING AND ECONOMICS

44355 (ORAU/IEA—79-8(R)) **Shale oil: U.S. and world resources and prospects for near-term commercialization in the United States.** Marland, G. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Mar 1979. Contract EY-76-C-05-0033. 59p. Dep. NTIS, PC A04/MF A01.

Although the United States has large resources of shale oil, several decades of development effort have yet to result in a viable industry. Because both the cost of the oil and the environmental impact of its production are not well known and seem to remain perennially at the margin of acceptability, the matter of commercialization has become a political issue. A variety of economic incentives and government programs to encourage commercial development have been proposed - some implemented - and several industrial corporations are proceeding cautiously. Conflicting political, economic, and environmental views, however, continue to preclude a decisive commitment and it does not appear at this time that significant quantities of shale oil will be available in the next decade, or probably even longer.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44249, 44250, 44251, 44258, 45372

44356 (DOE/EV/70031—4) **Critique of the meteorological and air quality baseline monitoring program for the prototype oil shale leaseholds. Part A: comments on the approach taken and recommendations for a continuing program. Part B: comments on the data acquisition and management.** Slinn, W.G.N.; Wolf, M.A.; Hennessey, J.P. Jr. (Oregon State Univ., Corvallis (USA). Air Resources Center). Nov 1978. Contract EY-76-S-06-2227-031. 58p. (RLO—2227-T31-4). Dep. NTIS, PC A04/MF A01.

In Part A of this report, it is contened that the meteorology and air quality baseline monitoring portion of the environmental protection program instituted at the prototype, federal oil shale leaseholds was an inappropriate response to the single, critical question: What will be the environmental impact if the extensive oil shale resources of Colorado, Utah, and Wyoming are developed to augment the nation's energy needs. With this pressing question sill unanswered, reasons are suggested why existing knowledge is inadequate to provide a valid answer. Furthermore, a means is proposed for accomplishing this important task within a suitable time-period and at a reasonable level of funding. In Part B, the probable cause of deficiences is identified in the meteorological and air quality data which were acquired over a two-year period on the federal oil shale leaseholds and are improved procedures for future data acquisition efforts are recommended.

44357 (PB—284480) **Epa program status report: oil shale.** Eckstein, L. (Cameron Engineers, Inc., Denver, CO (USA)). Feb 1978. Contract EPA-68-01-4337. 57p. NTIS PC A04/MF A01.

This report provides the reader with an overview of current oil shale research and development (R and D) efforts being performed by EPA, or being funded by EPA monies passed-through to other Federal agencies under the Interagency Energy/Environment R and D Program. Chapter 1 introduces the reader to the purpose, background, and rationale behind EPA's efforts; Chapter 2 discusses the EPA program goals and fiscal year 1977 program funding; and, Chapter 3 presents the scope-of-work for 55 ongoing projects. A table at the end of Chapter 3 summarizes these projects by presenting project title, sponsoring agency, performing organization, and project duration.

NUCLEAR FUELS

RESERVES

44358 (GJO—001(79)) **National Uranium Resource Evaluation, Plainview Quadrangle, Texas.** Amaral, E.J. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Mar 1979. Contract EY-76-C-13-1664. 76p. Dep. NTIS, PC A05/MF A01.

Uranium resources of the Plainview Quadrangle, Texas were evaluated to a depth of 1,500 m (5,000 ft) using available surface and subsurface geological information. Uranium occurrences reported in the literature and in reports of the Atomic Energy Commission were located, sampled, and described in detail. Areas of anomalous radioactivity, interpreted from an aerial radiometric survey, and geochemical anomalies, interpreted from a hydrogeochemical and stream-sediment reconnaissance, were also investigated. Five uranium occurrences, previously unreported in the literature, were located during outcrop reconnaissance. Areas of uranium favorability in the subsurface were evaluated using gamma-ray well logs and descriptive logs of well sample cuttings. Four areas of uranium favorability were delineated within the quadrangle. Delineation was based on both surface and subsurface data. Three of these areas are in fluvial and lacustrine facies of the Triassic Dockum Group. The fourth area, in the northeast part of the quadrangle, is characterized by arkosic alluvial fan and fluvial facies of Late Pennsylvania and Early Permian age. Geologic units considered to be unfavorable include nearly all the Permian rocks, the Pliocene Ogallala Formation and Pleistocene sediments, and portions of the Triassic Dockum Group and the Upper Pennsylvanian-Lower Permian rocks. Recommendations for improving the reliability of this evaluation are detailed aerial and ground radiometric surveys and the drilling of eight test holes for detailed subsurface information.

EXPLORATION

44359 (GJBX—48(79)(Vol.1)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska Quadrangles. Volume I. Narrative report.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 264p. Dep. NTIS, PC E09/MF E09.

A rotary-wing, reconnaissance high sensitivity radiometric and magnetic survey covering the Alaska portion of twenty-nine 1:250,000 UTMS quadrangles. A total of 21,409 line miles (34,455 line kilometers) of data were collected during the 1976 and 1977 flying seasons. This report covers only the Southeastern area comprised of the Skagway, Atlin, Mt. Fairweather, Juneau, Taku River, Sitka, Port Alexander, Sumdum, Petersburg, Bradfield Canal, Craig, Dixon Entrance, Ketchikan, and Prince Rupert NTMS 1:250,000 scale quadrangles which were flown during the 1976 and 1977 seasons. The radiometric data were normalized to 400 feet terrain clearance. The data are presented in the form of computer listings on microfiche and as stacked profile plots. A geologic interpretation of the radiometric and magnetic data is included in this volume.

44360 (GJBX—49(79)(Vol.1)) **Aerial gamma ray and magnetic survey: Rockies/Laramie Range Project, Denver and Pueblo Quadrangles, Colorado. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Mar 1979. Contract EY-76-C-13-1664. 242p. Dep. NTIS, PC E08/MF E08.

Under the Department of Energy (DOE) National Uranium Resource Evaluation (NURE) Program, GeoMetrics, Inc. conducted a high sensitivity airborne radiometric and magnetic survey of the Denver and Pueblo 1:250,000 Quadrangles in the State of Colorado. All field data were returned to the GeoMetrics, Sunnyvale, California computer facilities for processing, statistical analysis, and interpretation. Data presented are: corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperatures, and airborne bismuth contribution. Radiometric data presented are corrected for Compton Scatter, altitude dependence, and atmospheric bismuth. These data are also presented on microfiche and digital magnetic tapes. This report also contains anomaly maps and interpretation maps relating mapped geology to the corrected radiometric and magnetic data. These final two quadrangles of the Rockies/Laramie Project covered primarily two principal contrasting geologic environments: (1) the mountainous structural uplifts (dominated by the Front Range Uplift) with their exposed Precambrian rocks in the west, and; (2) the deep, sedimentary basins (dominated by the Denver Basin) of the plains country in the east. Radiometric count rates in the basins were generally lower than those over the crystalline rocks of the uplifts. An exception to this is the Dawson Formation in the plains of the Denver Quadrangle. Corrected gamma ray profiles and statistical analysis defined known uranium districts such as Central City, Ralston Creek, and Tallahassee Creek as well as potentially new areas outside of developed regions.

44361 (GJBX—67(79)(Vol.1)) **Aerial radiometric and magnetic survey: Tularosa National Topographic Map, New Mexico.** (Geodata International, Inc., Dallas, TX (USA)). 15 Dec 1978. Contract EY-76-C-13-1664. 146p. Dep. NTIS, PC E10/MF E10.

A description of the program and the results from the airborne gamma ray and total magnetic field survey of the Tularosa region of New Mexico are given.

44362 (GJBX—67(79)(Vol.2)) **Aerial radiometric and magnetic survey: Tularosa National Topographic Map, New Mexico.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 133p. Dep. NTIS, PC A07/MF A01.

Volume 2 contains the flight line profile data and statistical results from the aerial radiometric and magnetic survey of the Tularosa region of New Mexico.

44363 (GJBX—69(79)(Vol.2)) **Aerial radiometric and magnetic survey: Beeville/Bay City National Topographic Map, Texas Gulf Coast.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 229p. Dep. NTIS, PC A11/MF A01.

The flight line profile data and the statistical analysis results from the aerial radiometric and magnetic survey of the Texas Gulf Coast are presented.

44364 (GJBX—84(79)) **Hydrogeochemical and stream sediment reconnaissance basic data for Joplin NTMS Quadrangle, Kansas; Missouri.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 13 Apr 1979. Contract EY-76-C-13-1664. 248p. (K/UR—122). Dep. NTIS, PC E06/MF E06.

Results of a reconnaissance geochemical survey of the Joplin Quadrangle, Kansas and Missouri are reported. Field and laboratory data are presented for 736 groundwater and 714 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwater data indicate that the most promising area for potential uranium mineralization occurs in the north central part of the quadrangle. Rocks in this area belong to the Pennsylvanian Pleasanton, Kansas City, and Marmaton Groups. Groundwaters from the Marmaton and Pleasanton Groups were samples mostly from dug wells and probably reflect surface geology and contamination. Groundwaters taken from the Kansas City and Pleasanton Groups are often located within oil fields and may be influenced by brines. Stream sediment data indicate high uranium values occurring primarily in the northeast within the Pennsylvanian Cherokee Group and along the eastern edge of the Marmaton Group. The associated elements indicate that anomalous uranium is derived from phosphatic and pyritic black shales.

44365 (GJBX—86(79)) **Savannah River Laboratory semiannual report, October 1978—March 1979. Hydrogeochemical and stream sediment reconnaissance.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1979. Contract EY-76-C-09-0001. 51p. Dep. NTIS, PC A04/MF A01.

This report summarizes the accomplishments, status, and program of the Savannah River Laboratory (SRL) contribution to the National Uranium Resource Evaluation (NURE) program. SRL has accepted responsibility for Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of 1,500,000 square miles in 30 eastern and 7 far western states. The report is a progress report covering the period October 1978 through March 1979. SRL efforts in the following areas are discussed: orientation, reconnaissance, and anomaly follow-up in geological programs; management, analysis, and interpretation of analytical and field data; reporting of HSSR results; and sample preparation methods, neutron activation analysis, and other analytical techniques. Appendix A to the report summarizes the SRL-NURE production of the October 1978—March 1979 period and the program plans for the second half of FY-1979. Page scale maps are included showing the status of completed sampling, analaysis, and Data Releases placed on open file. Appendix B presents preliminary data and evaluation from a study of the seasonal variability of uranium concentrations in ground and surface waters. Appendix C summarizes results from a Little Rock, Arkansas, orientation study. Appendix D describes results of tests of SRL's ion exchange techniques in highly alkaline waters.

44366 (GJBX—89(79)) **Hydrogeochemical and stream sediment reconnaissance report for the Tonopah NTMS Quadrangle, Nevada.** Qualheim, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract EY-76-C-13-1664. 136p. (UCRL—52676). Dep. NTIS, PC E04/MF E04.

The results of the geochemical reconnaissance sampling in the Tonopah 1° x 2° quadrangle of the National Topographical Map Series (NTMS) are presented. We collected wet and dry sediment samples throughout the 19,000-km², arid-to-semiarid area and water samples at available streams, springs, and wells. Neutron activation analysis of uranium and trace elements and other measurements made in the field and laboratory are presented in tabular hardcopy and microfiche format. The report includes five full-size overlays for use with the Tonopah NTMS 1:250,000 quadrangle. Water sampling sites, water-sample uranium concentrations, water-sample conductivity, sediment sampling sites, and sediment-sample total uranium and thorium concentrations are shown on the separate overlays. General geological and structural descriptions of the area are included and known uranium occurrences in this quadrangle are delineated.

44367 (IS—4691) **Multilaboratory analytical quality control for the hydrogeochemical and stream sediment reconnaissance. Quality control report for April 1979.** D'Silva, A.P.;Floyd, M.A.; Haas, W.J. Jr. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 51p. Dep. NTIS, PC A04/MF A01.

LASL shows a negative bias in their fluorometric analysis of water B4 and their delayed neutron counting analysis of sediments R1 and T1. ORGDP shows positive bias in their fluorometric analysis of sediment R1. ORGDP also shows negative bias when analyzing sediment S1 by delayed neutron counting. The interlaboratory comparisons for water B4 reveal that LASL and ORGDP are reporting statistically different results. The comparisons for water A4 and sediment R1 show LASL and ORDGP to be in agreement.

44368 (PB—287899) **Application of plate tectonics to the location of new mineral targets in the Appalachians. Semiannual progress report no. 2.** Kutina, J.; Rabchevsky, G. (American Univ., Washington, DC). Jun 1978. 154p. NTIS PC A08/MF A01.

The report discusses the application of plate tectonics to the location of new mineral targets in the Appalachians. These results provide a new structural-geological framework for a metallogenic study by: recognizing a block structure of a broad territory extending westward from the Appalachian folded belt; finding a relationship between the curvature of the Appalachian folded belt and the boundaries of blocks of the Precambrian basement; and postulating the presence of three major lineaments, extending east-westerly along southern and northern boundaries of major basins and uplifts, which are supposed to reflect major fracture zones of the Precambrian basement. The spacing between the east-west lineaments was of the same order of magnitude as spacing between the transfer faults which displace the crest of the Mid-Atlantic Ocean Ridge. This may represent relics of basement fractures of the plates that moved away from the rift zone. These findings have led to a study of the distribution and occurrence of deposits of the individual metals superimposed on the new structural base. The distribution of epigenetic uranium is presented in Part A. Part B includes two manuscripts describing work completed in remote sensing studies.

44369 (GJBX—48(79)(Vol.2)(Mt.Fairweather)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Mt. Fairweather Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 135p. Dep. NTIS, PC A07/MF A01.

The flight line profile data and statistical analysis results from the aerial gamma-ray and magnetic reconnaissance survey of the Mt. Fairweather region of Alaska are presented. (LK)

ENRICHMENT

CENTRIFUGATION

44370 (N—78-29916) **System analysis of plasma centrifuges and sputtering. Final report, 1 November 1976—31 October 1977.** Hong, S.H. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). May 1978. Contract NGR-06-002-147. 141p. NTIS PC A07/MF A01.

System analyses of cylindrical plasma centrifuges are presented, for which the velocity field and electromagnetic fields are calculated. The effects of different electrode geometrics, induced magnetic fields, Hall-effect, and secondary flows are discussed. It is shown that speeds of 10000 m/sec can be achieved in plasma centrifuges, and that an efficient separation of U238 and U235 in uranium plasmas is feasible. The external boundary-value problem for the deposition of sputtering products is reduced to a Fredholm integral equation, which is solved analytically by means of the method of successive approximations.

LASER EXCITATION

REFER ALSO TO CITATION(S) 45194

44371 **Mathematical model of non-equilibrium condensation in one- and two-dimensional two-phase flows.** Mathieu, P. (Institut de Thermodynamique, Liege, Belgium). *Lett. Heat Mass Transfer;* **6**: No. 1, 61-71(Jan 1979).

A new method of uranium isotope separation is proposed, based on an aerodynamic process involving nonequilibrium heterogeneous condensation of gaseous UF_6 in presence of an isotopic selective laser photoexcitation. In order to study processes based on two-phase flows with mass transfer, the nonequilibrium condensation of a vapor in one- and two-dimensional configurations is theoretically investigated. A new formulation of the system of differential equations replacing the condensate mass fraction equation is proposed which allows a numerical resolution of the conservation equations in a two-dimensional geometry.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 44757

SPENT FUELS REPROCESSING

44372 (GA-A—14978) **Stress and vibration measurement in the uniframe cold engineering-scale HTGR fuel element size reduction system.** Crabtree, R.D.; Cramer, G.T.; Steeger, E.J. (General

Atomic Co., San Diego, CA (USA)). May 1979. Contract EY-76-C-03-0167-053. 69p. Dep. NTIS, PC A04/MF A01.

The UNIFRAME, a three-stage crushing machine for size reduction of high-temperature gas-cooled reactor (HTGR) fuel elements, was instrumented to measure the crushing forces and the dynamic displacements during operation. A combination of strain gages installed on the moving-jaw reaction-toggle links and load cells placed at the stationary-jaw upper-support points permitted determination of the magnitude and direction of the effective crushing force. By this technique, a maximum crushing force of 23,000 kg was observed for the primary jaw crusher and 20,800 kg for the secondary jaw crusher. The forces used for design were 102,500 kg for the primary and 91,600 kg for the secondary, resulting in margins of safety of 3.5 and 3.4, respectively. A peak lateral dynamic displacement at the top of the frame of 0.63 cm, as determined by accelerometer measurements, verified the predicted value of 0.68 cm determined using MODSAP, a dynamic structural analysis code, thereby establishing confidence in the structural model. A MODSAP seismic analysis of the crushing machine frame, with a 0.25 g peak ground acceleration, results in a maximum predicted displacement at the top of the frame of 0.49 cm in the more flexible Y direction (perpendicular to jaw motion) and 0.41 cm in the stiff X direction (parallel to the jaw motion). During seismic response, a peak bending stress of 64.11 MPa (9,300 psi) is developed at the base of the support frame close to the anchor points. Results confirm that the structural design is conservative.

44373 (GA-A—15404) **Control and instrumentation of a fluidized bed burner.** Fields, D.E.; McNair, J.M.; Rickman, W.S. (General Atomic Co., San Diego, CA (USA)). May 1979. Contract DE-AT03-76SF1053. 8p. (CONF-790803—4). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Techniques have been developed for automated operation of fluidized-bed combustors. Both a 0.20-m (8-in.) and a 0.40-m (16-in.) diameter burner have been used during this program with deep fluid beds (length/diameter > 5) of crushed graphite. Full instrumentation of process variables was provided, including flow, temperature, pressure, etc. An online 50-channel process computer-controller monitored each control loop. A supervisory computer has also been used for data logging, data presentation during operation, and supervisory manipulation of process computer set points. Excellent burner control has been attained, with bed temperature controlled to +- 10°C (18°F) over long time durations and with fluid bed material balance data continuously calculated. This work, funded by the Department of Energy throughout, has been directed toward processing crushed graphite fuel elements discharged from nuclear reactors. As the process knowledge of fluid-bed combustion advanced, more attention was given to instrumentation and control to gain the following benefits: improved transient response; more consistent product characteristics; ease of operation; more detailed data analysis; on-line material accountability (important when working with nuclear materials); safer operation due to programmed logic and fail-safe shutdown systems. Significant progress has been made toward these goals.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 44405

44374 (AECL—6301) **Conceptual design study of a concrete canister spent-fuel storage facility.** Lidfors, E.D.; Tabe, T.; Johnson, H.M. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jan 1979. 80p. Dep. NTIS (US Sales Only), PC A05/MF A01.

A conceptual design study for the interim storage of CANDU (CANada Deuterium Uranium) spent fuel in concrete canisters is presented. The canisters will be concrete flasks, which contain fuel prepackaged in double steel containment, and will be cooled by natural air convection. This is one of the methods proposed as a potential alternative to water pool storage. A preliminary study of this concept was done by CAFS (Committee Assessing Fuel Storage), and WNRE (Whiteshell Nuclear Research Establishment) is currently conducting a development and demonstration program. This study of a central facility for the storage of all Canadian spent fuel arisings to the year 2000 was completed in 1975. A brief description of the facilities required and the operations involved, a summary of costs, a survey of the monitoring requirements and a prediction of the personnel exposures associated with this method of storing spent fuel are reported here. The estimated total cost of interim storage in cylindrical canisters at a central site is $6.02/kg U (1975 dollars). Approximately half of this cost is incurred in the shipment of fuel from the reactors to the storage facility.

44375 (DPSTD-SFHP—78-10) **Spent fuel receipt and lag storage facility for the spent fuel handling and packaging program.** Black, J.E.; King, F.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jan 1979. Contract EY-76-C-09-0001. 281p. Dep. NTIS, PC A13/MF A01.

Savannah River Laboratory (SRL) is participating in the Spent Fuel Handling and Packaging Program for retrievable, near-surface storage of spent light water reactor (LWR) fuel. One of SRL's responsibilities is to provide a technical description of the wet fuel receipt and lag storage part of the Spent Fuel Handling and Packaging (SFHP) facility. This document is the required technical description.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 44797

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 44890

44376 (ORNL/TM—6866) **High-level waste program. Progress report, October 1, 1978—March 31, 1979.** Blanco, R.E.; Lotts, A.L. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 54p. Dep. NTIS, PC A04/MF A01.

Development of a low-level waste management analysis computer code has been initiated. As part of an ongoing update of the ORIGEN code, models of PWRs fueled with denatured ^{233}U and denatured ^{235}U in ThO_2 are being developed. Information on waste management for 18 alternative fuel cycles has been assembled for use by NASAP. Documentation of experimental and calculational work done for the assessment of partitioning and transmutation is progressng, while the conceptual design, cost estimation, and risk analysis of partitioning and waste disposal facilities are scheduled for completion in September 1979. Assuming diffusion control, leach studies with FUETAP concretes indicate effective diffusivities in the order of $\leqq 10^{-10}$ cm^2/s for plutonium, cesium, and strontium, respectively. Hydrogen and oxygen combine rapidly at ambient temperature in the presence of FUETAP concrete. A spray calciner is currently being fabricated and installed in a trailer laboratory. New cermet sintering techniques have been developed which drastically reduce the sintering temperatures and times required to achieve satisfactory densification. The radioisotope volatility losses observed during the processing of actual wastes to form cermets were very low. Conversions of actual SRP acid and dried sludge wastes to cermets have been performed. A series of cermet leach tests conducted by PNL have been completed, and the samples are currently being examined at ORNL. Results indicate that cermets exhibit promising leach resistance and durability.

44377 (RHO-LD—90) **Long-term transuranic defense waste management program overview.** Manry, C.W. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). May 1979. Contract EY-77-C-06-1030. 56p. Dep. NTIS, PC A04/MF A01.

Purpose is to assess alternatives, develop technology, and provide the necessary data base to implement the waste management alternatives selected for the transuranic and low-level wastes at Hanford. The program has been divided into two phases: technology development and operations. Interfaces with other programs and schedules are discussed. (DLC)

WASTE PROCESSING

44378 (MLM—2611) **Development of ultrafiltration and adsorbents: October 1978—March 1979.** Herald, W.R.; Roberts, R.C. (Mound Lab., Miamisburg, OH (USA)). 14 May 1979. Contract EY-76-C-04-0053. 22p. Dep. NTIS, PC A02/MF A01.

Studies were conducted to determine the feasibility of using a bone char adsorption column or a reverse osmosis (RO) unit as a treatment secondary to ultrafiltration for Mound aqueous waste. Results showed RO to be much more effective than bone char as a secondary treatment. Tests were performed to determine whether RO would also remove americium-241 from a waste stream. (Plutonium was removed in previous tests.) The results of these tests showed nearly complete removal of americium-241. Data collected from almost 2 yr of operation show that the M-type ultrafiltration membranes are more suitable than D membranes for use in a full-scale system. A literature search is being conducted to find adsorbents for the removal of fission products from waste streams. Adsorbers for cesium have been identified and testing to determine their effectiveness has started. The literature identified by computer search for iodine and cobalt adsorbers is now being studied. Engineering column decontamination factors for americium-241 removal

from waste streams with pH of 3, 7, and 10 were determined. A cross reference of adsorbents was compiled in a series of tables so that data from waste treatment reports can be compared.

44379 (MLM—2614) **Pelletized waste form demonstration program: October 1978—March 1979.** Lewis, E.L.; Herbert, R.F. Jr. (Mound Facility, Miamisburg, OH (USA)). 15 May 1979. Contract EY-76-C-04-0053. 14p. Dep. NTIS, PC A02/MF A01.

During the last six months, feasibility studies involving cold laboratory experiments were conducted. These experiments produced data on cold simulated sludge characteristics, sludge loading percentages for the sludge/cement matrices, effect of additives on strength and handling characteristics, and optimum water/cement ratios most applicable for sludge/cement pellets. Incinerator ashes from LASL and SRP were successfully immobilized using the cement pelletization process, thus indicating the process is adaptable and compatible with other incinerator ash compositions. Some short-term radiolysis performance testing of pelletized wastes is in progress at the Savannah River Plant. In addition, radiolysis and leachability test procedures were developed which will be used for performance testing here at Mound Facility.

44380 (MLM—2618) **Defense waste cyclone incinerator demonstration program: October—March 1979.** Klinger, L.M. (Mound Lab., Miamisburg, OH (USA)). 22 May 1979. Contract EY-76-C-04-0053. 14p. Dep. NTIS, PC A02/MF A01.

The cyclone incinerator developed at Mound has proven to be an effective tool for waste volume reduction. During the first half of FY-1979, efforts have been made to increase the versatility of the system. Incinerator development was continued in three areas. Design changes were drafted for the present developmental incinerator to rectify several minor operational deficiencies of the system. Improvements will be limited to redesign unless installation is required to prove design or to permit implementation of other portions of the plan. The applications development portion of the feasibility plan is focused upon expanding the versatility of the incinerator. An improved delivery system was installed for burning various liquids. An improved continuous feed system was installed and will be demonstrated later this year. Late in FY-1979, work will begin on the conceptual design of a production cyclone incinerator which will handle nonrecoverable TRU waste, and which will fully demonstrate the capabilities of the cyclone incinerator system. Data generated in past years and during FY-1979 are being collected to establish cyclone incineration effects on solids, liquids, and gases in the system. Data reflecting equipment life cycles and corrosion have been tabulated. Basic design criteria for a cyclone incinerator system based on developmental work on the incinerator through FY-1979 have been assembled. The portion of the material dealing with batch-type operation of the incinerator will be published later this year.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 45472, 45490, 45491, 45492

44381 (DP—1518) **Transmutation of waste actinides in light water reactors.** Gorrell, T.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1979. Contract EY-76-C-09-0001. 49p. Dep. NTIS, PC A03/MF A01.

Actinide recycle and transmutation calculations were made for three irradiation options of a light water reactor (LWR). The cases considered were: all actinides recycled in regular uranium fuel assemblies; transuranic actinides recycled in separate MOX assemblies with ^{235}U enrichment of uranium; and transuranic actinides recycled in separate MOX assemblies with plutonium enrichment of natural uranium. When all actinides were recycled in a uniform lattice, the transuranic inventory after ten recycles was 38% of the inventory accumulated without recycle. When the transuranics from two regular uranium assemblies were combined with those recycled from a MOX assembly, the transuranic inventory was reduced 50% after five recycles.

44382 (DPSPU—79-11-7) **History of Tank 23, 1962 through 1974.** McNatt, F.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Apr 1979. Contract EY-76-C-09-0001. 44p. Dep. NTIS, PC A03/MF A01.

Tank 23 was placed in service in April 1964 receiving contaminated water from Buildings 244-H, the Receiving Basin for Off-Site Fuel (RBOF), and 245-H, the Resin Regeneration Facility (RRF). Tank 23 also provided emergency storage space for 500,000 gallons in the event of a severe contamination incident in Building 244-H. The tank has remained in this service since that time. The Tank 23 waste was processed initially by the 242-H evaporator, but since mid-1966 the waste has been processed through a zeolite bed to remove ^{137}C and other radioisotopes by ion exchange, and discarded to seepage basins. Inspections of the tank interior were made by using a 40-ft optical periscope and the thickness of the steel bottom of the tank was measured ultrasonically. Samples of the waste in the tank and liquid collected in the side wall and bottom sumps were analyzed. Several equipment modifications and repairs were made.

44383 (LBL—7069) **Preliminary thermal and thermomechanical modeling for the near surface test facility heater experiments at Hanford. Volume II: Appendix D.** Chan, T.; Remer, J.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 192p. Dep. NTIS, PC A09/MF A01.

Appendix D is a complete set of figures illustrating the detailed calculations necessary for designing the heater experiments at the Near Surface Test Facility (NSTF) at Hanford, Washington. The discussion of the thermal and thermomechanical modeling that yielded these calculations is presented in Volume 1. A summary of the figures and the models they illustrate is given in table D1. The most important figures have also been included in the discussion in Volume 1, and Table D2 lists the figure numbers in this volume that correspond to figure numbers used there.

44384 (LBL—7096) **Geotechnical assessment and instrumentation needs for nuclear waste isolation in crystalline and argillaceous rocks.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 229p. (CONF-780730—). Dep. NTIS, PC A11/MF A01.

From Geotechnical assessment and instrumentation needs symposium; Berkeley, CA, USA (16 Jul 1978).

To evaluate the state-of-the-art, research needs, and research priorities related to waste disposal in largely impermeable rocks, scientists and engineers working on geologic aspects of nuclear waste disposal were brought together. This report and recommendations are the proceedings from that symposium. Three panels were organized on rock properties, fracture hydrology, and geochemistry. Panel discussions and recommendations are presented. (DLC)

44385 (LBL—8285) **Geochemistry and isotope hydrology of groundwaters in the Stripa Granite: results and preliminary interpretation.** Fritz, P.; Barker, J.F.; Gale, J.E. (Waterloo Univ., Ontario (Canada). Dept. of Earth Sciences; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 141p. (SAC—12). Dep. NTIS, PC A07/MF A01.

The results of geochemical and isotopic analyses on water samples from the granite at Stripa, Sweden, are presented. Groundwater samples collected from shallow, private wells; surface boreholes; and boreholes drilled from the 330 m and 410 m mine levels were analyzed for their major ion chemistry, dissolved gases, and environmental isotope contents. The principal change in the chemical load with depth is typified by chloride concentration, which increases from less than 5 mg/liter to about 300 mg/liter. There is a parallel increase in pH, which changes from about 6.5 to over 9.75. It is important to notice that calcite saturation is maintained and that, because of rising pH, dissolved inorganic carbon is lost. The total carbonate content thus decreases from about 70 mg/liter to less than 7 mg/liter. The ^{18}O and deuterium analyses demonstrate that different fracture systems contain different water masses, whose age increases with depth. Groundwater age determinations with ^{14}C and isotopes of the uranium decay series strongly indicate that water ages exceed 25,000 years. The ^{13}C contents of the aqueous carbonate in these groundwaters indicate groundwater recharge through vegetated soil, presumably during an interglacial period. The ^{13}C and ^{18}O determinations show that most fracture calcites have formed in a wide variety of depositional environments, and not in the waters circulating today.

44386 (NTIS/PS—78/1234) **Radioactive waste disposal in salt deposits (a bibliography with abstracts). Report for 1964—November 1978.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1978. 174p. NTIS PC N01/MF N01.

This bibliography cites Government sponsored research reports on underground disposal of radioactive wastes in salt deposits. The citations cover radiation protection, disposal efficiency, site selection, site stability, mathematical models, and hydrology. (This updated bibliography contains 168 abstracts, 77 of which are new entries to the previous edition.)

44387 (PB—288339) **Development and application of a risk assessment method for radioactive waste management. Volume I. Generic description of AMRAW-A model.** Logan, S.E.; Berbano, M.C. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Jul 1978. Contract EPA-68-01-3256. 174p. NTIS PC A08/MF A01.

A Radioactive Waste Management Systems Model, is presented. The systems model and associated computer code called AMRAW (Assessment Method for Radioactive Waste), has two parts. The first part, AMRAW-A, consists of the Source Term (radioactive inventory versus time), the Release Model, and the Environmental Model. The Release Model considers various geologic and man-caused events which are potential mechanisms for release of radioactive material beyond the immediate environs of a repository or other location; the risk analysis mode uses events distributed

probabilistically over time, and the consequence analysis mode uses discrete events occurring at specified times. The Environmental Model includes: (1) the transport to and accumulations at various receptors in the biosphere, (2) pathways from these environmental concentrations, and (3) resulting radiation dose to man. The second part of the systems model, AMRAW-B, is the Economic Model which calculates health effects corresponding to the various organ dose rates from AMRAW-A, collects these health effects in terms of economic costs and attributes these costs to radionuclides, decay groups, and elements initially in the waste inventory. Implementation, with calculated results, of AMRAW for Terminal Storage in a Bedded Salt Reference Repository are presented. Preliminary demonstrations for the repository operations phase of waste management and terminal storage in a shale formation are described; possible applications to other radioactive and nonradioactive hazardous materials are discussed. AMRAW uniquely links all steps together in a continuous calculation sequence.

44388 (PB—288340) **Development and application of a risk assessment method for radioactive waste management. Volume II. Implementation for terminal storage in reference repository and other applications.** Logan, S.E.; Berbano, M.C. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Jul 1978. Contract EPA-68-01-3256. 392p. NTIS PC A17/MF A01.

A Radioactive Waste Management Systems Model, is presented. The systems model and associated computer code called AMRAW (Assessment Method for Radioactive Waste), has two parts. The first part, AMRAW-A, consists of the Source Term (radioactive inventory versus time), the Release Model, and the Environmental Model. The second part of the systems model, AMRAW-B, is the Economic Model which calculates health effects corresponding to the various organ dose rates from AMRAW-A, collects these health effects in terms of economic costs and attributes these costs to radionuclides, decay groups, and elements initially in the waste inventory. The generic description of AMRAW-A is presented in Vol. I. Implementation of the model and computer code for terminal storage in a bedded salt reference repository is presented in Part 1 of this volume. The model is not limited to the application described here; demonstration applications to other phases of the radioactive waste management sequence, and to another geologic setting are given in Part 2 of this volume.

44389 (PB—288341) **Development and application of a risk assessment method for radioactive waste management. Volume III. Economic analysis; description and implementation of AMRAW-B model.** Logan, S.E.; Schulze, W.D.; Ben-David, S.; Brookshire, D.S. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Jul 1978. Contract EPA-68-01-3256. 168p. NTIS PC A08/MF A01.

A Radioactive Waste Management Systems Model, is presented. The systems model and associated computer code called AMRAW (Assessment Method for Radioactive Waste), has two parts. The first part, AMRAW-A, consists of the Source Term (radioactive inventory versus time), the Release Model, and the Environmental Model. The second part of the systems model, AMRAW-B, is the Economic Model which calculates health effects corresponding to the various organ dose rates from AMRAW-A, collects these health effects in terms of economic costs and attributes these costs to radionuclides, decay groups, and elements initially in the waste inventory. This volume describes AMRAW-B, the Economics Model, and is in two parts: Part 1 presents a generic description of the AMRAW-B model, background economic theory and a description of the AMRAW-B computer code, and Part 2 presents implementation of the model with an application to terminal storage in a bedded salt reference repository.

44390 (PB—288342) **Development and application of a risk assessment method for radioactive waste management. Volume IV. AMRAW computer code. user's manual.** Logan, S.E. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Jul 1978. Contract EPA-68-01-3256. 177p. NTIS PC A09/MF A01.

A Radioactive Waste Management Systems Model, is presented. The systems model and associated computer code called AMRAW (Assessment Method for Radioactive Waste), has two parts. The first part, AMRAW-A, consists of the Source Term (radioactive inventory versus time), the Release Model, and the Environmental Model. The second part of the systems model, AMRAW-B, is the Economic Model which calculates health effects corresponding to the various organ dose rates from AMRAW-A, collects these health effects in terms of economic costs and attributes these costs to radionuclides, decay groups, and elements initially in the waste inventory. A user's guide for AMRAW-A is presented in Part 1 and for AMRAW-B in Part 2 of this volume.

44391 (SAND—78-0893) **Interaction of radionuclides with argillite from the Eleana Formation on the Nevada Test Site.** Dosch, R.G.; Lynch, A.W. (Sandia Labs., Albuquerque, NM (USA)). Feb 1979. Contract EY-76-C-04-0789. 50p. Dep. NTIS, PC A03/MF A01.

Distribution coefficients have been determined for ^{137}Cs, ^{85}Sr, ^{144}Ce, ^{99}Tc, ^{152}Eu, ^{238}Pu, ^{244}Cm, and ^{243}Am between argillite from the Eleana Formation on the Nevada Test Site (NTS) and several aqueous phases. Radionuclide concentrations in the range of 1 to 0.001 μCi/ml were used with contact times of 14, 28, and 56 days. Reaction mechanism, concentration effects, exchange capacity, equilibration times, and particle size effects were addressed in a more comprehensive study of the interaction of argillite with Cs in deionized water. The experimental parameters used in the distribution coefficient measurements were based in part on this work. The aqueous phases included a simulated groundwater with composition based on the analysis of a NTS groundwater, the same simulant and deionized water which were pre-equilibrated with powdered argillite, and a groundwater simulant with approximately the same qualitative composition of the NTS simulant, but with a higher ionic strength. A system to provide continuous pH control by CO_2 addition during equilibration of the argillite-solution mixtures was designed and assembled. Initial experiments were done with Cs and Eu and the effects of pH on their distribution coefficients are discussed.

44392 (SAND—78-1730) **Scenarios for long-term release of radionuclides from a nuclear-waste repository in the Los Medanos region of New Mexico.** Bingham, F.W.; Barr, G.E. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 167p. Dep. NTIS, PC A08/MF A01.

This report discusses hypothetical sequences of events that could conceivably release radionuclides from radioactive waste buried in the proposed WIPP repository. All the scenarios are described in terms specific to the WIPP site; they include only events whose occurrence is physically possible there. The report estimates the relative probabilities of the scenarios at times ranging from 1000 to 1 million years after the repository is sealed. Although none of the scenarios is judged likely, the report recommends several for detailed computer modeling and consequence analysis.

44393 (UCID—18122) **Preliminary area selection considerations for radioactive waste repositories in bedded salt.** Wagoner, J.L.; Steinborn, T.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jun 1979. Contract W-7405-ENG-48. 52p. Dep. NTIS, PC A04/MF A01.

This guide describes an approach to selection of areas of bedded salt which contain potentially suitable sites for the storage of radioactive waste. To evaluate a site selected by a license applicant, it is necessary to understand the technical site characteristics which should be considered in the preliminary phase of site selection. These site characteristics are presented here in checklist form, and each item is accompanied by a discussion which explains its significance. These qualitative considerations are used first to select an area of interest within a broad geologic or geomorphic region. Once an area has been selected, more quantitative information must be acquired to determine whether the proposed site meets the resultations for storage of nuclear waste.

44394 (UCRL—15014) **Preliminary assessment of the thermal effects of an annular air space surrounding an emplaced nuclear waste canister.** Davis, B.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Apr 1979. Contract W-7405-ENG-218. 45p. Dep. NTIS, PC A03/MF A01.

Modeling results have previously shown that the presence of a large air space (e.g., a repository room) within a nuclear waste repository is expected to cause a waste canister's temperature to remain cooler than it would otherwise be. Results presented herein show that an annular air space surrounding the waste canisters can have similar cooling effects under certain prescribable conditions; for a 16 ft x 1 ft diameter canister containing 650 PWR rods which initially generate a total of 4.61 kw, analysis will show that annular air spaces greater than 11 in will permit the canister surface to attain peak temperatures lower than that which would result from a zero-gap/perfect thermal contact. It was determined that the peak radial temperature gradient in the salt varies in proportion to the inverse of the drill hole radius. Thermal radiation is shown to be the dominant mode of heat transfer across an annular air space during the first two years after emplacement. Finally, a methodology is presented which will allow investigators to easily model radiation and convection heat transfer through air spaces by treating the space as a conduction element that possesses non-linear temperature dependent conductivity.

44395 (Y/OWI/SUB—78/22303/10) **Analytical approximations to the thermoelastic behavior of repository configurations.** Callahan, G.D.; Gnirk, P.F. (RE/SPEC, Inc., Rapid City, SD (USA)). 6 Jan 1978. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

This report presents three different analytical solutions to approximate the surface uplift of a heated repository. The first solution assumes a temperature distribution which is a function only of the vertical coordinate (z) constant throughout the radius and the lateral strain is assumed to be zero. The second solution assumes a

temperature distribution which is a function of the radial coordinate (r) constant throughout the height and assumes no radial displacement at the outer boundary. The third solution is similar to the second solution, the difference being that the outer boundary is assumed to be traction free. The second solution is subsequently derived from the third solution by superposing the elastic solution obtained from imposing a constant radial displacement at the outer boundary of a solid cylinder. The first solution consistently gives the highest vertical displacements due to the lateral constraints. The solutions are summarized and specific temperature distribution forms are used to formulate expressions for the vertical displacements. Some example problems are presented with comparisons to previous finite element analyses of various repository models (bedded and dome salt). Generally, the first and second solutions appear to bound the finite-element computations of the surface uplift.

44396 (Y/OWI/SUB—78/22303/11) **Evaluation of the predictive capability of the finite element method: II. Project salt vault - thermo/viscoelastic simulation.** Ratigan, J.L.; Callahan, G.D. (RE/SPEC, Inc., Rapid City, SD (USA)). 17 Mar 1978. Contract W-7405-ENG-26. 62p. Dep. NTIS, PC A04/MF A01.

The study presents an assessment of the predictive capability of a two-dimensional finite element structural program by performing a simulation of the Project Salt Vault experiment and comparing the numerically computed deformations to those which were measured during the experiment. The numerical method is evaluated in addition to the geometric and chronological approximations and the salt characterization.

44397 (Y/OWI/SUB—78/22303/12) **Parametric thermoelastic analyses of high-level waste and spent fuel repositories in granite and other non-salt rock types.** Osnes, J.D.; Wagner, R.A.; Waldman, H. (RE/SPEC, Inc., Rapid City, SD (USA)). 25 Apr 1978. Contract W-7405-ENG-26. 86p. Dep. NTIS, PC A05/MF A01.

The global thermomechanical behavior of a radioactive waste repository was examined and such parameters as rock type, gross thermal loading, waste type, waste age, repository depth, and in-situ stress state were considered. This was accomplished by use of the finite element method and was completed in two phases: (1) a preliminary investigation of the thermal behavior of a repository with respect to host rock type was made using thermal properties typical of a uniform rock mass composed of either granite, limestone, or shale; and (2) a comprehensive thermal and thermoeladtic analysis was made using typical thermomechanical properties of granite.

44398 **Sorption behavior of trivalent actinides and rare earths on clay minerals.** Friedman, A.M.; Fried, S. (Argonne National Lab., IL). pp 201-213 of Radioactive waste in geologic storage. Fried, S. (ed.). Washington, DC; American Chemical Society (1979).

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

Distribution coefficients were measured as a function of Na^+ concentration by batch methods on attapulgite, montmorillonite, and kaolinite. Am, Cm, Cf, Es, La, Sm, Cs, Rb, K, and Sr tracers in brines were used. Attapulgite was found to take very long, up to 9 days, to come to equilibrium, whereas the other two clays take less than 15 min. There is very little difference between the rare earths and actinides. 8 figures, 3 tables. (DLC)

44399 **Consequences of radiation from sorbed transplutonium elements on clays selected for waste isolation.** Haire, R.G.; Beall, G.W. (Oak Ridge National Lab., TN). pp 291-295 of Radioactive waste in geologic storage. Fried, S. (ed.). Washington, DC; American Chemical Society (1979).

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

This paper reports the initial results of experiments with ^{253}Es—clay mixtures and the tentative implications these results have for the other transplutonium elements. Two naturally occurring clays were used: kaolin and attapulgite. Results showed that, even though the clay structures were destroyed by the ^{253}Es radiation, the distribution ratios (Es clay/solution) did not drop drastically with time but in fact increased slightly. (DLC)

44400 (UCRL-Trans—11453) **Leaching process of radionuclides from solidified wastes and its mathematical analyses.** Terasima, Y. Translated from *Doboku Gakkai Ronbun Hokokushu;* No. 209, 51-61(Jan 1973). 39p. Dep. NTIS, PC A03/MF A01.

This paper first discusses the chief velocity processes connected with leaching rate control. On the basis of the leaching mechanism, and with consideration of the IAEA's tentative guidelines, unification of the terminology connected with leaching phenomena is proposed and the meaning of the terms used as indicators is clarified. During study of the possibility of boundary layer diffusion rate control, new coefficients are introduced and the mechanisms formulated in cases where dissolution and diffusion in the solid phase govern the leaching in fine solidified wastes and in cases where diffusion in interstitial gaps governs the leaching in porous solidified wastes. Leaching rates are derived for the test units proposed in the IAEA's tentative guidelines and for actual-scale solidified wastes, and methods for determining the diffusion coefficients and other relevant coefficients for cases including those where both dissolution and diffusion processes occur simultaneously are studied. Methods are also studied for estimating the long-term changes in leaching for actual-scale solidified wastes.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44392, 44400, 45339, 45359, 45373, 45374, 45376

44401 (PNL—2850(Pt.2), pp 10.9-10.10) **Decommissioning and decontamination (300 Area burial ground) studies.** Fitzner, R.E. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Progress is reported in the decommissioning and decontamination of retired Hanford facilities and planning the future use of surrounding landscapes. Ecological studies were developed to characterize the 300 Area waste burial grounds and to determine the potential for biotic transport of buried contaminated wastes away from managed facilities.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 44387, 44388, 44389, 44390, 44858, 45471

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 44414

44402 (ALO—0789-T5) **Integrated IAEA safeguards concepts for nuclear critical facilities.** (Argonne National Lab., IL (USA); Los Alamos Scientific Lab., NM (USA); Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 18p. Dep. NTIS, PC A02/MF A01.

Only high-inventory critical facilities were considered. Goal of the study was to develop an independent capability for detecting the protracted or abrupt diversion of fuel containing 8 kg of plutonium or 25 kg of the uranium isotope 235 within approximately 1 week of the diversion. It is concluded that a practical and effective international safeguards system for critical facilities can be achieved. Such a system would involve methods of monitoring movement of materials and people and would maintain a running inventory that is tested periodically by independent inventory sampling. This monitoring would detect inventory and procedural discrepancies as well as unauthorized removal of nuclear materials. A special inventory may be taken following a monitoring alarm to confirm a suspected diversion. Comparison of various safeguards options led to the selection, for further development, of a system which uses a combination of surveillance and inspection by resident International Atomic Energy Agency (IAEA) personnel, containment/surveillance by unattended equipment, and periodic routine inventory verification. The safeguards system concepts were developed for a reference critical facility having a split-table horizontal matrix; however, a system designed for an actual facility would necessarily incorporate facility-specific features. Development of special equipment for such systems must include preliminary operational tests and evaluations of these concepts in an operating facility to determine their effectiveness and acceptability. 4 figures, 5 tables.

44403 (LA—7706-PR) **Nuclear safeguards research and development. Program status report, September—December 1978.** Gardner, S.D. (ed.). (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 54p. Dep. NTIS, PC A04/MF A01.

This report presents the status of the Nuclear Safeguards Research and Development program pursued by the Los Alamos Scientific Laboratory Safeguards Group Q-1, Q-2, Q-3, Q-4, and Q-5. Topics covered include nondestructive assay technology development and applications, international safeguards, perimeter safeguards and surveillance, concepts and subsystems development (e.g., DYMAC program), integrated safeguards systems, training courses, and technology transfer.

44404 (LA—7823-M) **Description and operation manual for the active well coincidence counter.** Menlove, H.O. (Los Alamos Scientif-

ic Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 37p. Dep. NTIS, PC A03/MF A01.

An Active Well Coincidence Counter (AWCC) has been developed to assay uranium fuel material in field inspection applications. The operation of the AWCC is based on active neutron interrogation using a small AmLi neutron source and counting the induced fission neutrons with high-efficiency ^{3}He detectors operated in the coincidence mode. In comparison with the conventional fast random driver assay system, the AWCC is more portable, lightweight, stable and less subject to gamma-ray backgrounds. The unit is useful for the measurement of bulk UO_2 samples, high-enrichment uranium metals, LWR fuel pellets, and ^{235}U-Th fuel materials, which have very high gamma-ray backgrounds. By removing the AmLi source, the unit can measure ^{238}U and plutonium in the passive neutron coincidence mode. This manual describes the system components, setup, calibration, and operation of the AWCC, which has been developed for field inspection applications by IAEA inspectors.

44405 (NUREG—0561) **Physical protection of shipments of irradiated reactor fuel.** Kasun, D.J. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). May 1979. 35p. NTIS, PC A03/MF A01.

During May 1979 the U.S. Nuclear Regulatory Commission approved for issuance in effective form new interim regulations for strengthening the protection of spent fuel shipments against sabotage and diversion. The new regulations will likely continue in force until the completion of an ongoing research program concerning the response of spent fuel to certain forms of sabotage. At that time the regulations may be rescinded, modified, or made permanent, as appropriate. This report discusses the new regulations and provides a basis on which licensees can develop an acceptable interim program for the protection of spent fuel shipments.

44406 (NUREG/CR—0683) **Statistical methods for evaluating sequential material balance data.** Wincek, M.A.; Stewart, K.B.; Piepel, G.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 184p. (PNL—2920). Dep. NTIS, PC A09/MF A01.

The report considers the material balance model where the only modeled variability is that due to the measurements of the net throughput (inputs minus outputs) and the inventories. The problem discussed is how to extract more information from all the available data. Section 2 considers material balance models which assume no loss, while Section 3 considers the constant loss and all-at-once loss situations. Emphasis was placed on explaining state variable models and Kalman filtering in relation to the general linear statistical model to which least squares is applied yielding a minimum variance unbiased estimator. All errors affecting material balances were assumed to be random.

44407 (SAND—79-0052) **Evaluation of the AN/GSS-20 motion detection system.** (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

A series of tests was performed on the AN/GSS-20 motion detection system. The primary objectives of these tests were to determine sensor detection patterns and to quantitate the effects of intruder velocity. System susceptibility to environmental factors was also examined.

44408 (SAND—79-0257) **Evaluation of the RACON 15000 microwave motion detection system.** (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

A series of tests was performed on the RACON 15000 motion detection system. The primary objectives of these tests were to determine sensor detection patterns and to quantitate the effects of intruder velocity. System susceptibility to fluorescent lights, oscillatory motion, and environmental factors was also examined.

44409 (SAND—79-0258) **Evaluation of the peak MA-6600L microwave motion detection system.** (Sandia Labs., Albuquerque, NM (USA)). Feb 1979. Contract EY-76-C-04-0789. 42p. Dep. NTIS, PC A03/MF A01.

A series of tests was performed on the Peak MA-6600L motion detection system. The primary objectives of these tests were to determine sensor detection patterns and to quantitate the effects of intruder velocity. System susceptibility to fluorescent lights, oscillatory motion, and environmental factors was also examined.

44410 (SAND—79-0700) **Task Manager for the Motorola 6800.** Merillat, P.D. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

A nucleus of multi-tasking operating systems has been implemented on a Motorola 6800 microprocessor. This control structure, called a Task Manager, is appropriate for those real-time systems which are required to handle several different asynchronous events. The general concept of a Task Manager is described. A specific implementation for a Motorola 6800 microprocessor is given and its usage defined.

44411 **Role of barriers in a physical protection system.** Madsen, M.R. (Sandia Lab, Albuquerque, NM). *Nucl. Mater. Manage.;* 7: 392-399(1978).

The role and importance of barriers in an effective physical protection system and the limited effectiveness of traditional barriers is often overlooked. This paper attempts to define the role and importance of barriers (delay) and discusses some examples of the surprisingly short penetration times possible by properly equipped and determined adversaries. In addition, the on-going barrier evaluation and development program at Sandia Laboratories is briefly described with special emphasis on the Barrier Technology Handbook which documents the results of that program.

44412 **Tamper-indicating seal program development and implementation at Rockwell Hanford operations.** Jordan, K. (Rockwell Int, Richland, Wash). *Nucl. Mater. Manage.;* 7: 417-423(1978).

A tamper-indicating seal program has been developed and implemented at Rockwell Hanford Operations' source and special nuclear material facilities near Richland, Washington. The development effort resulted in written procedures that identify the level of containment at which seals are used, the types of seals that are used, the methods of seal control, application and inspection, and the actions to be taken if the integrity of a seal in use cannot be verified. This paper describes the development process and resultant procedures that blend these elements into the tamper-indicating seal program in effect at Rockwell Hanford Operations.

ADMINISTRATIVE AND REGULATORY

44413 **NRC's proposed screening program: values and pitfalls.** O'Brien, J.N. (Brookhaven Natl Lab, Upton, NY). *Nucl. Mater. Manage.;* 7: 258-266(1978).

In 1974 Congress passed into law an amendment to the Atomic Energy Act enabling the Nuclear Regulatory Commission (NRC) to establish a system of standards and specifications for screening employees in the licensed nuclear energy industry. On March 17, 1977 NRC issued proposed rules outlining a clearance program for virtually all employees of licensed facilities, requiring the equivalent of a top secret or "Q" clearance for most. On December 28, 1977 NRC announced its intention to hold a hearing and at that time set forth the mechanism by which the rulemaking proceeding would be administered. The purpose of this paper is to present the major issues surrounding the decision which will face the Commission subsequent to the hearing.

FUSION FUELS

44414 (SAND—78-2041(Vol.4)(No.3)) **Sandia technology.** Lawrence, R.J.; Mead, P.L. (eds.). (Sandia Labs., Albuquerque, NM (USA)). Nov 1978. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

Developments and accomplishments at Sandia Laoratories in three diverse areas are described in a popular fashion. The Tritium Research Laboratory uses modern methods of dual containment to protect against accidental release of tritium. A newly developed transparent composite can withstand the impact of .30 caliber armor-piercing rounds and is intended for use in vehicles transporting nuclear and radioactive materials. A separate abstract was prepared on a deep-well solar irrigation experiment. (JSR)

PROCESSING

FABRICATION AND TESTING

44415 (UCRL—15008) **Investigation on fabrication and positioning of cryogenic shell laser fusion targets. Annual report, October 1, 1977—November 30, 1978.** Kim, K. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). 1978. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

The research has been directed toward fabrication and positioning of cryogenic shell laser fusion targets, with particular emphasis on the development of a scheme which would allow for continuous fabrication, inspection, and delivery of the targets. Specifically, progress has been made in each of the following areas: (1) fabrication of a uniform layer of solid DT inside a glass microshell using a combination of helium gas jets and a heater wire; (2) levitation-freezing of a DT-filled glass microshell as a method for fabricating and positioning a cryogenic shell target; (3) a target fabrication system intended for continuous fabrication, inspection, and delivery of cryogenic targets; and (4) development of diagnostics for inspec-

tion, recording, and analysis of a solid DT layer inside a glass microshell, and for observing the parameters controlling the target freezing process.

44416 Method for producing small hollow spheres. Hendricks, C.D. (to Dept. of Energy). US Patent 4,133,854. 9 Jan 1979. Filed date 16 Jun 1977. 8p.
PAT-APPL-807,108.

A method is described for producing small hollow spheres of glass, metal or plastic, wherein the sphere material is mixed with or contains as part of the composition a blowing agent which decomposes at high temperature ($T > \sim 600°C$). As the temperature is quickly raised, the blowing agent decomposes and the resulting gas expands from within, thus forming a hollow sphere of controllable thickness. The thus produced hollow spheres (20 to 10^3 μm) have a variety of application, and are particularly useful in the fabrication of targets for laser implosion such as neutron sources, laser fusion physics studies, and laser initiated fusion power plants.

44417 Laser target fabrication, structure and method for its fabrication. Farnum, E.H.; Fries, R.J. (to Dept. of Energy). US Patent Application 928,027. 25 Jul 1978. 9p.

The disclosure is directed to a laser target structure and its method of fabrication. The target structure comprises a target plate containing an orifice across which a pair of crosshairs are affixed. A microsphere is affixed to the crosshairs and enclosed by at least one hollow shell comprising two hemispheres attached together and to the crosshairs so that the microsphere is juxtapositioned at the center of the shell.

44418 Method and apparatus for forming targets using light pulses. Woerner, R.L. (to Dept. of Energy). US Patent Application 924,336. 13 Jul 1978. 20p.

Apparatus and method for cryoinduced uniform deposition of cryogenic materials, such as deuterium-tritium (DT) mixtures, on the inner surface of hollow spherical members, such as inertially imploded targets, is disclosed. By vaporizing and quickly refreezing cryogenic materials contained within a hollow spherical member, a uniform layer of the materials is formed on the inner surface of the spherical member. Heating of the cryogenic material, located within a nonisothermal compact freezing cell, is accomplished by a light pulse, such as a laser beam, whereafter the material is quickly frozen forming a uniform layer on the inner surface of the spherical member.

PROPERTIES

44419 Decomposition pressures in the ($\alpha+\beta$) fields of the Li-LiH, Li-LiD, and Li-LiT systems. Veleckis, E. (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* 79: No. 1, 20-27(Jan 1979).

Decomposition ('plateau') pressures of H_2, D_2, and T_2 over Li-LiH, Li-LiD, and Li-LiT alloys were determined between 600 and 850°C, for pressures ranging from 3 to 460 Torr, and for alloy compositions falling within the ($\alpha+\beta$) miscibility gaps. The measurements were carried out separately for each hydrogen isotope using the same lithium sample and experimental procedures. For each system the lnP vs. 1/T data form a pair of linear segments, the intersection of which represents the monotectic temperature (694°C for Li-LiH, 690°C for Li-LiD, and 688°C for Li-LiT). For a given temperature plateau pressures were in the order $P_{sub}(T_2) > P_{sub}(D_2) > P_{sub}(H_2)$. The D/H isotope effects in pressure varied from 1.48 and 1.74 at 600°C to 1.34 and 1.45 at 850°C. The results were used to calculate the standard free energies of formation of solid LiH, LiD, and LiT. The tritium gas used in this study had significant amounts of hydrogen and deuterium. A method for correcting the plateau pressures of this mixture to those of pure tritium is presented.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 45393

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

RADIATION SOURCES

44420 (SAND—79-0642C) Bremsstrahlung generation development and radiation effects studies. Beezhold, W. (Sandia Labs., Albuquerque, NM); Evans, D.C.; Woodall, H.N.; Keller, D.V.; Rice, D.A. (Sandia Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-790706—3). Dep. NTIS, PC A02/MF A01.

From 1979 IEEE Annual conference on nuclear and space radiation effects; Santa Cruz, CA, USA (17 Jul 1979).

Pulsed relativistic electron beams have been used for years in conjunction with high atomic number converters to produce intense, short duration bremmstrahlung photon pulses for testing electronic components and circuits. Potential damage mechanisms include: thermomechanical failure caused by deposition-induced stresses, burn-out, and latch-up or other failures produced by induced currents or voltages. These various effects are dependent upon the total deposited dose x, the peak dose rate x', and dose x' acceleration x''. A new short pulse electron accelerator has been used to generate a shorter x-ray pulse capability, with the attendant increased dose rates x' and x''. The first purpose of the paper is to describe the development of the new x-ray source. Discussed are: (1) the diode design; (2) the magnetic field transport of the electrons to assure a cool beam and high conversion efficiency to x-rays; (3) the present Sandia Laboratories, Albuquerque, (SLA) converter technology; and (4) the results of the photon diagnostics of the dose, dose rates, and the dose versus axial position from the converter. The second purpose of the paper is to report the results of initial experiments carried out on a small group of selected integrated circuits. Several failure modes were identified. While the component tests are preliminary, the results are presented to illustrate that the new laboratoryx-ray source indeed produces several of the damage effects mentioned above. These new x-ray levels are higher than those obtained from any other laboratory source.

DESIGN AND FABRICATION

44421 (N—78-33424) Anomalous dispersion and the pumping of far infrared (fir) lasers. Lawandy, N.M. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 11p. NTIS PC A02/MF A01.

It is shown that the anomalous dispersion at the pump transition in molecular far-infrared lasers (FIR) can lead to sizable focusing and defocusing effects. Criteria for beam spreading and trapping are considered with CH^3F as an example.

44422 (N—78-33538) Nuclear electric power sources. Singh, J.J. (National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center). Sep 1978. 23p. NTIS PC A02/MF A01.

Measurements on radioactive commercial p-n junction silicon cells show that these units are capable of delivering several hundred microwatts per curie of 241-Am alpha source, indicating their usefulness in such electronic devices as hearing aids, heart pacemakers, electronic watches, delay timers and nuclear dosimeter chargers. It is concluded that the 241-Am sources are superior to the beta sources used previously, because of higher alpha specific ionization and simultaneous production of low energy photons which are easily converted into photoelectrons for additional power.

OTHER INDUSTRIAL USES

44423 (AD-A—058307) Applications of the radioisotope wear measurement technique. Technical report. Birkmire, R.; Niiler, A. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Jun 1978. 28p. NTIS PC A03/MF A01.

Erosive wear has been measured from gun steel surfaces by detecting the loss of the radioisotope ^{56}Co which has been introduced into the surface layers. The ^{56}Co activity is produced by means of the $^{56}Fe(p,n)\,^{56}Co$ reaction when the steel is bombarded by a beam of protons. A detailed calibration curve, relating the amount of ^{56}Co activity to the amount of surface material worn off, has been measured and is applicable to all steel surfaces. This method has a precision of + or - 0.1 micrometers, can be performed in a short time, in-situ, and without surface cleaning. Three experiments in which this method has been used are discussed. In the first, a land on a 20 mm barrel was activated and the wear measured under several different firing conditions. In the second, wear was measured from an activated plug inserted into a land of the 20 mm barrel. In the third, steel erosion nozzles were exposed to several different propellants and wear losses as well as mass losses were measured. The correlation between the two methods is very good. Possible applications of this method to a variety of wear measurement experiments are discussed.

HYDROGEN

REFER ALSO TO CITATION(S) 44546

44424 (PB—286636) **Hydrogen energy. A bibliography with abstracts. Annual supplement, 1974.** Natarajan, M. (New Mexico Univ., Albuquerque (USA). Technology Application Center). [nd]. Contract NASW-2936. 240p. NTIS PC E11/MF E11.

The Hydrogen Energy 1974 supplement is a bibliographic series that contains citations and abstracts from over 7000 different sources devoted to hydrogen as a synthetic fuel or energy carrier. Foreign and domestic publications are cited, abstracted and indexed. For easy reference the Hydrogen Energy Quarterly is divided into five sections: general, production, utilization, combustion, transmission, distribution and storage and safety.

PRODUCTION

44425 **Seminar on hydrogen as an energy vector: its production, use and transportation.** Luxembourg; Commission of the European Communities (1978). 592p. (In several languages). (EUR—6085; CONF-7810162—). European Community Information Service, 2100 M Street, NW, Washington, DC.

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Individual papers were prepared for inclusion in the data base. The papers cover thermochemical production of hydrogen, electrolytic production of hydrogen, and hydrogen use, storage, and transportation. (LK)

ELECTROLYSIS

REFER ALSO TO CITATION(S) 44446, 44447, 44448, 44449

44426 **Electrochemical reduction of water vapor. State of development of an assembly of flat cells.** Viguie, J.C. (Centre d'Etudes Nucleaires de Grenoble, France). pp 310-327 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The working conditions of an electrolyzer are described. Great variations of water vapor concentration through the battery makes us advocate for piling up flat cells working under a constant potential. A 50 cm^2 half cathodic cell has been fabricated. The solid electrolyte is made of zirconia (0.91 ZrO_2, 0.09 Y_2O_3) associated with an embedded layer of nickel powder as the cathode. The disc is supported by a honeycomb shaped ceramic which is covered by a layer of nickel. The most promising method for solid electrolyte fabrication is the powder compaction and sintering process. The plasma jet projection gave interesting results and can be considered as an alternative process. A test set working at 850°C is on the way. It will give information on the stability of the prepared parts and allow us to measure the characteristics of the planar cell.

44427 **Pulsed electrocatalytic dissociation of water vapour.** Cunningham, J.; Morrissey, D.J. (Univ. College Cork, Ireland). pp 13-28 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

An experimental study has been made of factors influencing the efficiencies and release-times for evolution of pulses of gaseous hydrogen or oxygen products from the pulsed electrocatalytic dissociation of water vapor on various metal—oxide surfaces. Rapid evolution of well-formed pulses of hydrogen product is demonstrated upon application of cathodic voltages between -2.5 and -25V to one face of doped zirconia discs at temperatures 900 to 1200°K. At 1110°K the rise-time of hydrogen product upon application of the cathodic potential, and its decay-times following removal of the potential were characterized by t/sub 1/2/ = 2s and 4s, respectively, with the result that maximum repetition rate for formation and evolution of well-resolved hydrogen pulses was 0.1 Hz. Two factors contributing to the low efficiency attainable in this pulsed electrocatalytic mode of hydrogen production were: (1) space-charge limitations on the transfer of charge to the catalyst surface and (2) low probability for adsorption and dissociation of a water molecule in any one passage across the electrode surface. Formation and evolution of oxygen pulses at even lower efficiencies and with longer decay times has been demonstrated but the longer decay times cause difficulties in resolving oxygen pulses from each other and from hydrogen.

44428 **Alkaline inorganic—membrane—electrolyte water electrolysis.** Vandenborre, H.; Leysen, R.; Tollenboom, J.P.; Baetsle, L.H. pp 161-165 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

A research program aiming at the development of a new advanced electrolysis concept in alkaline water electrolysis cells has been initiated at SCK/CEN under the auspices of the European Communities. It is envisaged to substitute the asbestos diaphragm which is presently used in alkaline electrolysis technologies by an heterogeneous membrane based on inorganic material. The inorganic-membrane;electrolyte (IME) under investigation is mainly composed of polyantimonic acid and possesses promising gas separating and ion conducting properties. The anodes are perforated nickel plates, catalytically activated by thermally decomposed nickel—cobalt oxide. The same type of perforated plates but coated with platinum is used as cathode. Circular electrolysis unit cells with a geometrical surface area of 4 cm^2 are tested up to 0.5 MPa (5 bar) gas pressure under electrolyte flow. Cell voltages of 1.8 V at 10 kAm^{-2} were obtained in a reproducible way at the operating temperature 100 to 120°C. A 1 kW filterpress-type multicell has been designed and is in construction, in order to evaluate the applicabilities of the IME-concept in advanced alkaline water electrolysis, operating up to 150°C and up to 4 MPa (40 bar) gas pressure.

44429 **New catalysts and separators for the electrolysis of water: first optimization of functional parameters.** pp 166-180 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The development of better electrocatalysts for oxygen and hydrogen evolution leads to a change in traditional electrolyzer conception: in particular thin potassium titanate based separators, bipolar sintered electrodes and flow of electrolyte between electrode and separator become essential features as well as pressurization.

44430 **Application of electrocatalysis to the electrolysis of water at high temperature and high current density.** Prigent, M. (Institut Francais du Petrole, Rueil Malmaison, France); Mas, L.J. pp 181-193 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Alkaline water electrolysis can be improved by using electrocatalysts on both cathode and anode. The gains obtainable at temperatures between 80°C and 200°C in 36% KOH electrolyte under a pressure of 22 bars are determined with various catalytic materials. Short duration screening tests are first run on small plain electrodes at 80°C and atmospheric pressure. Promising catalysts are then subjected to more extensive studies, for longer times and in more severe conditions, using larger electrodes of industrial design. A test facility has been built which comprises 6 cells, and is fully automated. Each cell has its own auxiliaries and can be operated independently. The catalysts studied are nickel sulfide or finely divided nickel obtained from nickel—zinc or nickel—aluminium alloys at the cathode side, and lanthanum—strontium—cobalt mixed semiconducting oxides at the anode side. In the best case the hydrogen and oxygen overpotential can be lowered by 0.2 to 0.35 volt even at current densities of up to 10 $kA.m^{-2}$. A cell using a thin asbestos diaphragm and nickel gauze electrodes covered with catalysts was operated at 10 $kA.m^{-2}$ and 200°C; the voltage remained lower than 1,6 V during the 125 hours of continuous operation.

44431 **Anodic materials for the electrolysis of water.** Fiori, G.; Formaro, L.; Mari, C.M.; Scolari, P.V.; Vago, L. (Univ. of Milan, Italy). pp 194-211 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The oxygen evolution reaction has been studied on a new type of electrodic material based on mixed oxides of perovskite-like structure, the general formula of which is $MeLn_3O_4$. On the basis of the kinetic parameters obtained in a far-from-equilibrium situation in KOH solutions (0.1 to 6 M), it has been possible to determine the mechanism of the reaction as being constituted by two initial electrochemical steps, the second of which is rate determining. The change in the Tafel slope from low to high current densities is explained in terms of the active sites occupation of the electrode surface. To test the practical applicability of these materials in industrial water electrolysis, current-potential curve have been obtained at temperatures as high as 120°C in 30% KOH and the potential time behavior for several hundred hours has been determined. The obtained results are compared with recently published results on other nontraditional anodic materials.

44432 Electrolytic production of hydrogen from alkaline solutions: active electrodes for KOH electrolysis. Nidola, A. (Impianti Elettrochimici SpA, Milan, Italy); Spaziante, P.M.; Giuffre, L. pp 212-228 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

New electrocatalysts for hydrogen and oxygen evolution electode reactions in 29 wt % KOH electrolysis at atmospheric pressure and at 70°C have been studied and developed by Oronzio De Nora, Impianti Elettrochimici SpA. Cathodic catalysts include ruthenium and rhenium deposited on iron electrode bases via galvanic or plasma jet technique while anodic catalysts include steel activated Ni and/or cobalt on Ni coated Fe or Ni electrode bases via plasma jet route. The coatings in respect to commercial catalysts, which include nickel and/or iron sulphide, show in practice the following advantages: low overpotential for the wanted reaction even at high current density (10 kA/m²); absence of catalytic aging phenomena vs operation time and current density; and no asbestos diaphragm deterioration. The relatively low amount of catalysts (≦ 50 g/m² for anodic coatings, ≦ 20 g/m² for cathodic coatings) deposited on electrode bases makes them attractive for the hydrogen electrolytic production by electrolysis of KOH solutions provided that a current denstiy at least ≧ 3.0 kA/m² is used.

44433 Amelioration of asbestos-based diaphragms and the possibility of their replacement with semi-permeable membranes. Hausmann, E. pp 229-241 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In German)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Objective of our work is the testing of commercially available and self-developed diaphragm materials. The tests have concerned the following physical properties: (a) liquid-permeability; (b) gas-permeability; (c) specific electrical resistance; (d) behavior of the diaphragm inside an electrochemical cell, i.e., influence on the voltage drop and chemical stability. Until now only the first part of the research program has been concluded; the second part will concern electrolysis tests at pressures higher than atmospheric with novel types of diaphragm. Our work shows that it is very difficult to find a material which is totally equivalent to asbestos. At the present state of the technique, an asbestos diaphragm has a durability of about 6 to 7 years of operation. Very promising results have been obtained with a two-layers diaphragm Polypropylene-PTFE. This diaphragm has inside the electrolysis cell a resistance comparable to that of asbestos and tests carried out over a period of about 1.100 hours do not show significant deterioration.

44434 Separators for the electrolytic production of hydrogen. Giuffre', L. (Politecnico di Milano, Italy); Spaziante, P.M.; Nidola, A.; Modica, G. pp 242-254 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In Italian)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

A series of separators were obtained by the polymerization in situ of 4-vinylpyridine with divinylbenzene directly over a porous support. According to the quantity of copolymer deposited, we obtain either diaphragms or membranes. Another type of separators applicable in electrolytic cells for hydrogen production from sulphuric acid solutions has been obtained by depositing polymers of styrene type on inert supports. These deposited copolymers have been sulfonated to make them hydrophilous and ion-selective. Another type of copolymer for the preparation of separators has been obtained by sulfonating the copolymer of tetrafluoroethylene and acrylic acid.

44435 Optimization of gas evolving teflon-bonded electrodes. Man, M.C.M.; Jasem, S.; Yeung, K.L.K.; Tseung, A.C.C. (City Univ., London, England). pp 255-275 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

This study shows that $NiCo_2O_4$ and the propriety catalyst are active catalysts for the anode and the cathode of the alkaline water electrolyzer at temperatures below 100°C. Further studies on the $NiCo_2O_4$ anode catalyst have confirmed that freeze drying is the best preparation method for this catalyst. The incorporation of Teflon into the electrode structure provides dry, porous channels for the gas to escape during the gas evolution reaction, thus ensuring greater utilization of the available catalyst surface. The effect of modifying the hydrophobic nature of the Teflon bonded electrode surface is also discussed. Life test results (at 1 A/cm², 45% KOH, 70°C, with cell voltage of 1.65 +- 0.025 volts) confirms that the electrochemical stability of the catalysts and the mechanical strength of the Teflon bonded electrode are strong enough to be used for the alkaline water electrolyzer at temperatures below 100°C.

44436 Fundamentals and technological aspects of medium temperature (MT) high pressure (HP) water electrolysis. Fischer, J.; Hofmann, H.; Luft, G.; Wendt, H. (Technische Hochschule Darmstadt, Germany). pp 277-290 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

To improve costs for electrolytically produced hydrogen MT-HT-electrolysis (150 to 250°C; 30 to 100 bars) is one of the different promising options since thermal activation instead of electrocatalysis seems to be the most reliable way to decrease cell voltages. The project 047-76-EHD was performed in order to find the optimal technical conditions for a MT-HP-concept. Current-Voltage Curves for anodic O_2 and cathodic H_2-evolution were measured in an autoclave at temperatures between 80°C and 260°C in 30 and 50 wt% KOH at smooth nickel electrode. These measurements showed the principal feasibility of the concept for temperatures between 180° and 260°C. At 250°C at smooth nickel a practical cell voltages of 1.6 V at a current density of 1A/cm² is obtained. For the performance of the MT-HP-electrolysis concept a new diaphragm has to be found to substitute the usual asbestos diaphragm which is not stable against caustic dissolution at higher temperatures. Oxide-ceramic covered metal screens which can be produced with relatively low costs and which offer all necessary conditions: stability against caustic corrosion high hydraulic resistance (0.6 to 1 [cm² bar sec/cm³ centipoise]) and low electric resistance (0.05 to 0.1 [Ω.cm²] measured in 30 wt% KOH at 40°C) and high gas separation power (due to small pore diameter) are a new solution of the HT-diaphragm-problem. Cell and auxiliary equipment-construction may be based on normal steel equipped at the inside with 1-2 mm nickel-covers or sleeves. Projected H_2-production costs compare favorably with current production costs.

44437 Reduction of high temperature water vapor in a cell with solid oxide electrolyte. Electrochemical characterization of the elements of a cell. Schouler, E.; Fernandez, E.; Kleitz, M. (Laboratoire d'Energetique Electrochimique (ENSEEG), Saint Martin d'Heres, France). pp 291-309 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The goal of this study was to assemble appropriate experimental set-ups for characterizing the electrolyte and electrodes used in high-temperature water-vapor electrolyzers. The main parameters to be determined were: the ionic conductivity of rather thin layers of electrolyte (200 to 500 μm), the hydrogen diffusion coefficient through them and the electrode overpotentials. The experiments were performed on ZrO_2—Y_2O_3 9% mole solid solutions and on the electrode: H_2—H_2O, Ni/ZrO_2—Y_2O_3 9% mole. The impedance diagram plotting was used to measure the conductivity and the overpotentials. The hydrogen permeability was determined by a technique derived from the gas potentiometry. Evidence of a detrimental blocking effect at the grain boundaries was clearly shown and it is concluded that the impurity composition of the electrolyte can markedly influence the overall electrolyte resistance. Under our experimental conditions the hydrogen permeation was very small. As to this point the technique developed by our partner (CENG) for preparing the electrolytes is adequate. On the other hand the hydrogen electrode overpotential appeared to be an essential parameter to be optimized.

44438 Thermodynamical conditioning of gases produced by water electrolysis. Kunstreich, S.; Murillo, M.C.; Sterlini, J. (Compagnie Electro-Mecanique (CEM), Le Bourget, France). pp 328-336 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

In the energetic balance of a hydrogen generation process by means of increased temperature water electrolysis, it is necessary to consider two additional sources of energy expenditures, generally neglected at lower temperatures: the heating of the make-up water up to the electrolysis temperature, and the latent heat of the amount of water, which is evaporated and saturates the output gases H_2 and O_2. If the electrolyzer plant has no external heat source, these terms limit the overall efficiency of the process to a theoretical maximum which depends on temperature, pressure and KOH concentration. This study proposes an energy recovery process by thermodynamical gas conditioning which allows simultaneously the gas—vapor separation, the heating of the make-up water up to the electrolysis temperature and the recovery of mechanical energy which can be

fed back to the plant and thus improves the maximum overall efficiency.

44439 Gas bubble behavior during water electrolysis. Sillen, C.W.M.P. pp 337-355 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Both hydrogen and oxygen bubble behavior have been investigated during the electrolysis of a 30% by weight KOH-solution at room temperature and atmospheric pressure using as electrodes nickel expanded metal gauzes and woven stainless steel gauzes coated with nickel. The bubbles originate at sites arbitrarily distributed over the gauze. The number of sites increases at increasing current density. The growth of bubbles attached to the electrode surface is diffusion-controlled, i.e., the bubble radius is proportional to the square root of time. Generally the growth rate increases at increasing current density or at decreasing pressure, however, the site on which a bubble grows, affects the growth too. When the diaphragm is placed against the working electrode, the expanded metal gauzes allow the bubbles to leave the gauze. If the woven gauzes are used, the bubbles get captured between the gauze and the diaphragm. The effect of the bubbles on the electrical resistance of the electrolyte is highly determined by a thin layer (~ 3 mm) stuck to the surface, with a high gas volume fraction. The contribution of bubbles in the bulk liquid is of minor importance. The electric resistance is found to be independent of current density.

44440 Electrolysis of the high temperature water vapor in a cell with stabilized zirconia solid electrolyte. Study of the behavior of a compact nickel—zirconia cermet cathode. Accorsi, R. pp 356-369 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

In this article, a cell for the electrolysis of water vapor at high temperature is described. It consists of a doped In_2O_3 anode, a stabilized zirconia solid electrolyte, and a nickel—zirconia compact cermet cathods. The performance of this cell was studied over a long period of time at 950°C and 1A/cm² with a 50% H_2—H_2O vapor mixture. It was found that it increases slowly with time. Examination of the cathode after operation shows degradation due to demixing of the cermet.

THERMOCHEMICAL PROCESSES

44441 Automatic flowsheet synthesis and optimization. Mustacchi, C.; Cena, V. (Analysis and Development of Energy Systems, Rome, Italy). pp 29-35 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

An automatic procedure implemented in the code SYREN has been developed to generate the optimal heat recovery network of a given process. Applications were made to several versions of a thermochemical watersplitting cycle (MK-16) and lead to the conclusion that the cycle itself has little potential. The results confirm that this procedure is a powerful tool in screening among processes at an early development stage.

44442 Vapor—liquid—equilibrium of the system H_2O/H_2SO_4. Hartman, H.; Lennartz, H.; Rafflenbeul, L. pp 36-45 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The vapor—liquid—equilibrium data given in the literature for the system H_2O/H_2SO_4 are not sufficient to calculate separation columns working at elevated temperatures. In the present paper it is shown which measuring devices may be used to get high-temperature vapor—liquid—equilibria. The corrosional problems with metallic equilibrium cells are described. A cell made in quartz glass, surrounded by a pressure vessel in steel will be shown as well as the two methods for measuring phase equilibria: measurements of p, T, x-data and measurements of p, T, x, y-data respectively. Finally the calculation of the vapor composition in the presence of chemical reactions is described.

44443 Gas- and liquid-side mass transfer coefficients and the equilibrium solubility for the SO_2/O_2—H_2O system. Hartman, H.; Bremen, J.; von Wolfersdorff, W.D.B. pp 46-57 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In German)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

For the design of technical absorption columns, mass transfer coefficients, interfacial areas and solubilities must be known. In this report an apparatus for measuring the absorption kinetics in the system SO_2/O_2—H_2O for pressures up to 50 bars will be described. Starting from various measuring methods, the stirring cell method after Danckwerts will be explained. The problems caused by the severe conditions of measurements are explained.

44444 Balance and optimization of separation processes in the sulfuric acid—bromine cycle. Knoche, K.F.; Wozny, G.; Cremer, H. pp 58-70 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

A computer program was developed to evaluate multi-component distillation and absorption in complex columns. Data routines for the pure components H_2O, SO_3, SO_2, O_2, and H_2SO_4 calculate enthalpies, entropies, vapor pressures and molar volumes and data routines for H_2SO_4—H_2O mixtures and SO_3—H_2O mixtures calculate phase equilibria and the enthalpies for the mixtures were developed. The simulation method for separation processes has been applied to a separation problem referring to a thermochemical water splitting cycle - the hydrobromic acid - sulfuric acid cycle of the JRC Ispra.

44445 Study of the liquid—vapor equilibria in the system bromine—hydrobromic acid—water. Lessart, P.; Benizri, R. pp 71-90 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

A bibliographic study was carried out on liquid—vapor equilibria relative to the ternary system H_2O—HBr—Br_2. The diagram corresponding to the binary system H_2O—Br_2 is known at atmospheric pressure. Data are available on the solubility of bromine in water and on the demixing zone of this binary system; some results of bromine solubility measurements in aqueous solutions of hydrobromic acid exist, while the miscibility region of the pseudo-ternary system H_2O—47% HBr—Br_2 is known at 20°C. However, the liquid—vapor equilibrium of the binary system H_2O—Br_2 has only been studied partially, and that of the ternary system H_2O—HBr—Br_2 not at all. A glass ebullioscope was built and a method developed to study these equilibria at atmospheric pressure in the concentration range of interest for evaluation of the MARK 13 thermochemical cycle (bromine—sulfur).

44446 Hybrid processes for hydrogen production. Seeger, W.; Steeb, H. pp 91-108 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In German)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

A systematic search for convenient electrochemical reactions for hybrid cycles is presented. The combination of redox-reactions from literature with a hydrogen or oxygen producing electrode reaction in aqueous solution yields a large number of possible cell reactions. The introduction of reasonable constraints such as maximum allowed cell voltage, price and availability of elements used leads to an appreciable reduction of this number. Feasibility considerations for the remaining reactions based on physical and chemical properties of the materials as well as experimental work on their realization in laboratory scale are reported. The selection procedure reveals 12 electrolytic reactions.

44447 Problems concerning the electrochemical step of the sulfuric acid hybrid cycle. Struck, B.D.; Junginger, R.; Boltersdorf, D.; Gehrmann, J. (Nuclear Research Center Juelich (KFA), Germany). pp 109-123 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The anodic oxidation of sulfur dioxide as a function of sulfuric acid concentration, temperature and pressure was studied. Measurements demonstrate that the sulfuric acid concentration should be lower than about 60 w/o in order to obtain reasonable catalysis of anodic sulfur dioxide oxidation. Anodic currents increase with increasing temperature and pressure at potentials within the slope of the current/potential plot. The system graphite (carbon) and very small amounts of hydrogen iodide proved to be a good catalyst of anodic sulfur dioxide oxidation. These very small amounts of hydrogen iodide can be separated by distillation in presence of sulfur dioxide before entering the high temperature step of the sulfuric acid hybrid cycle. For the separation of anolyte and catholyte in order to

prevent sulfur deposition at the cathode from sulfur dioxide out of the anode compartment a three compartment electrolytic cell with an intermediate electrolyte flow is suggested.

44448 Electrochemical oxidation of SO_2 in sulfuric acid media. pp 124-138 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Screening of various acid stable materials show that platinum and gold are the best electrocatalysts for SO_2 oxidation in sulfuric acid solution. Tests on porous catalyzed carbon electrodes do not indicate any relationship between catalytic activity and surface area. Intensities from 0.4 to 0.6 A/cm under 0.8 Volt can be obtained with relatively diluted H_2SO_4 (44%). Little influence of temperature (20 → 80°C) and SO_2 pressure is noticed.

44449 Hydrogen production by hybrid thermoelectrolytic cycles. Nidola, A.; Spaziante, P.M. (Impianti Elettrochimici SpA, Milan, Italy). pp 139-159 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Expected values for SPE cell voltage break down in the case of the electrolysis of: [HBr(conc)], [HBr(conc) + SO_2], and [H_2SO_4 + SO_2] solutions and a general review concerning a very preliminary electrochemical characterization of different electrocatalysts and solid polymer electrolytes or membranes are given and discussed.

STORAGE

REFER ALSO TO CITATION(S) 44425, 45091, 45092, 45093

CHEMISORPTION

44450 Hydrogen storage by means of reversible magnesium alloys. Guinet, P.; Halotier, D.; Perroud, P. (Centre d'Etudes Nucleaires, Grenoble, France). pp 373-391 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

It was found that sorption capacities of Mg_2Cu and Mg_2Ni remained almost constant, not only with high purity hydrogen as already shown, but also with hydrogen containing 0.1% O_2 at 300°C for about 100 hr or more. Ng_2Ni was found having better sorption capacity, greater sorption-description rate and weaker loss of capacity vs time than Mg_2Cu. Mg-5 at % Cu has higher capacity and better hydriding kinetics than those of Mg. Mg_2Si has a sorption capacity of about 2% at 300°C, higher than that of Mg_2Cu during repeated cycles. Mg_2Si and Mg_2Cu have sorption capacity differences of about 10% under 5 hr hydriding time. Mg-1.16 Si seems to have better capacity below 6 hr hydriding time than other Mg alloys with 1 at % Ag, In, Y Al and Zn. Several alloys like Mg_2Cd, Mg_2Sn, Mg-8 Al, Mg-2 Pd exhibited no or bad sorption capacities. After 25 sorption-desorption cycles Mg_2Cu and Mg_2Ni show opposite behavior concerning their grain size change: most of the Mg_2Cu grains keep unchanged, while Mg_2Ni grains are found finely divided. Initial coarse grains of Mg_2Ni hydride well, while fine powders are necessary with Mg-8 Al.

44451 Utilization of reversible hydrides for hydrogen storage. Darriet, B.; Pezat, M.; Hagenmuller, P. (Univ. of Bordeaux, Talence, France). pp 392-406 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The addition of metals or alloys whose hydrides have a high dissociation pressure allows a considerable increase in the hydrogenation rate of magnesium. The influence of the nature of the adjuvant and its concentration, and the influence of temperature and hydrogen pressure on the reaction rate have been carefully studied. The first results concerning the hydriding of magnesium rich alloys such as Mg_2Ca, La_2Mg_{17}, and $CeMg_{12}$ are presented. The hydriding mechanism of La_2Mg_{17} and $CeMg_{12}$ alloys is given.

UNDERGROUND

REFER ALSO TO CITATION(S) 44460

CRYOGENIC

44452 Hydrogen storage by use of cryoadsorbents in comparison to alternatives. Carpetis, C.; Peschka, W. (DFVLR-Inst. for Technical Physics, Stuttgart, Germany). pp 407-426 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The paper reports investigations on the techniques and economics of hydrogen storage by means of cryoadsorption. Also a comparison with alternative storage methods is included. The hydrogen storage capacity of several adsorbents in the temperature range from 65°K to 150°K has been investigated experimentally. Based on these data economics and operating conditions for minimum total costs of the system are calculated. Utilization-factor and capacity-factor parameters are shown to be decisive for outlining the favorable ranges of application for competitive hydrogen storage methods.

TRANSPORT

REFER ALSO TO CITATION(S) 44460

44453 Study of possibilities of converting gas transmission networks to hydrogen. Bezin, S.; Garat, A. pp 447-465 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Within the framework of contract No. 160-76 EHF between the European Communities Commission and Gaz de France a survey was made in order to study the possibilities of converting gas transmission networks to hydrogen. The following aspects have been seen: nature of the tubes, construction of the mains in situ, and operation of the pipes. A list of items peculiar to the transmission network that may influence their behavior under hydrogen pressure has been constituted. The possibilities of investigating under hydrogen pressure have been studied and test equipment has been built. Tests have been carried out on specimens originating from the basic materials and from the welds of new tubes chosen from the principal grades used in gas transmission. The tests under pure hydrogen pressure at stress levels close to yield strength of chosen steels reveal no abnormal behavior. The burst tests on discs under helium pressure and under hydrogen pressure, for several purities, confirm that gas-pipe steels are little sensitive to gaseous hydrogen embrittlement when as received.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 44458

SAFETY

44454 (LA—7820-PR) Critical review and assessment of environmental and safety problems in hydrogen energy systems. Progress report, October 1, 1977—September 30, 1978. Edeskuty, F.J.; Sheheen, N.N. (comps.). (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 249p. Dep. NTIS, PC A11/MF A01.

Numerous suggestions have been made for the use of hydrogen in energy systems. Because these suggestions imply a concomitant increase in the quantity of hydrogen that must be produced, shipped, stored, and used, the possible safety and environmental impacts of these suggestions must be carefully assessed. From our studies on the safety aspects of hydrogen energy systems, we have concluded that the problem of hydrogem embrittlement can be solved through further research. Existing regulations and standards are adequate to encompass hydrogen development close to present usage levels. Large increases in quantity or degree of public exposure may require reconsideration of existing standards. It appears that hydrogen gas can be safely transmitted by pipeline. Whether existing natural gas pipelines can be used for hydrogen transmission has not yet been established; however, the addition of hydrogen to natural gas in quantities up to about 10% would seem to present no problems. Hydrogen is commonly shipped as a cryogenic liquid over long distances in unattended rail tank cars (approximately one per day from Los Angeles to Chicago) or in over-the-road tractor-trailer units. No safety problems have been observed, and this method of shipment could be considerably expanded with existing technology. Initial investigation indicates that both the production of the necessary primary energy and its use in the production of hydrogen may

be detrimental to the environment; however, the generally positive impact of the end use of hydrogen will to some extent reduce the negative effect of the production process.

44455 Safety aspects of future European hydrogen technology. Tanner, W. (Dornier-System G.m.b.H., Friedrichshafen, Germany). pp 544-566 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In German)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

Safety or emergency regulations especially for hydrogen are practically nonexistant. Only for space application are there some instructions concerning the handling of liquid hydrogen. Safety regulations and standards for other inflamable gases - even for gas mixtures with a high content of hydrogen - are proclaimed and obeyed in all European countries. It shall be emphasized here that all combustibles are hazardous to a distant degree and that hydrogen is not really more dangerous than other gases either by nature or over the whole range of its application. Regarding a stepwise increase of hydrogen consumption, the existing safety regulations in the EC-countries in principle will be sufficient to guarantee a comparable safety for hydrogen as it today exists for natural gas if some precautions are taken into account due to the specific properties of hydrogen. Development of new techniques demands time and capital for investments, a safe hydrogen energy economy presupposes in addition the willingness of all people to handle this new form of energy with care mindful of its risks but not intimidated. That means, that the primary task for hydrogen safety considerations should consist in how to get people acquainted to the best of all combustible gases.

44456 Hydrogen: a safety risk?. Schoedel, J.P. pp 567-581 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

All fuels provide mankind with convenience generating energy, and they all bear a danger for mankind when unpurposely badly controlled or purposely misused. This paper outlines the potential dangers of hydrogen not only as a fuel, and the present state of art for a reliably controlled application. Doing so, we start with a summary of typical accidents and proceed over a description of hydrogen-properties to safety measures.

44457 Safety in the presence of hydrogen. Jungbluth, C.; Siegler, F.; Tellier, C. pp 582-590 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The physical and chemical properties of hydrogen are examined from the viewpoint of the risks caused by them. These risks are discussed and analyzed in depth under the following topics: thermodynamic effects of the expansion of hydrogen, gaseous diffusion, comparative accident statistics of hydrogen and natural gas, conditions for ignition of hydrogen, detection of nonflaming hydrogen leaks, and detection of hydrogen flames. Emphasis is placed on those characteristics which differentiate hydrogen from other gases. Areas of study are recommended.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 44425

44458 Use of non-fossil-derived hydrogen in coal conversion processes. Merrick, D.; Harrison, J.S. (National Coal Board, London, England). pp 466-481 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The paper summarises the results of a study of the use of non-fossil-derived hydrogen in coal conversion processes carried out by the National Coal Board under contract to the Commission of the European Communities. The detailed results are given in the Final Report on research project XII/797/76 068-76 EHUK by D. Merrick, M. St.J. Arnold, H. Audus and J.M. Topper (Oct 1977). The study comprised a technical and economic evaluation of the use of non-fossil-derived hydrogen in three processes, selected as representative of coal conversion technology. The processes are methanol synthesis, solid phase hydrogenation (hydrogasification) for substitute natural gas production and liquid phase hydrogenation (liquefaction) for the manufacture of liquid fuels. The introduction of non-fossil-derived hydrogen generally resulted in an increase in the conversion efficiency and carbon utilization, and a reduction in the number of component stages of the process. Economic evaluations were carried out to determine the price at which non-fossil-derived hydrogen would have to be available for its use in coal conversion processes to be preferable to the conventional (self-contained) route. The manufacture of synthetic fuels from non-fossil-derived hydrogen was also compared with the direct use of hydrogen. It was concluded that market conditions could exist in which the use of non-fossil-derived hydrogen in coal conversion would be preferable both to conventional coal conversion and to the direct use of the hydrogen, irrespective of the coal price.

44459 Hydrogen and the steel industry. Balter, J.F.; Stocker, G.; Gousty, Y. pp 482-505 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

There seems to be a possibility for hydrogen to be used in the European steel-industry; hydrogen could be used as a substitute for coke, or it could make it possible to produce synthetic scrap-iron. Technically, there does not seem to be any insuperable obstacle to the use of hydrogen in the steel-making process. But, the present study tends to show that the profitability of the use of hydrogen in the steel-industry depends on particular economic conditions. The profitability of hydrogen-based steel-making processes is essentially conditioned by the relative prices of coke, scrap-iron and hydrogen; in the present conditions there would not be any immediate interest in using hydrogen in the steel-industry: such are the prices of coke and scrap-iron that the use of hydrogen, if it was really possible, would entail heavy financial losses.

44460 Technico economic study of the use of hydrogen and methanol for road transport. Breelle, Y. (Institut Francais du Petrole, Rueil-Malmaison, France); Chauvel, A.; Gelin, P.; Leprince, P.; Meyer, C.; Petit, G. pp 506-530 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978).

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

CEA and IFP, with the support of EEC (contract 07076 EHF) began a study in 1977 with the objective of estimating the technico-economical feasibility of hydrogen and methanol applied to automotive traction. This paper describes in detail the part of the study related to hydrogen use as a motor fuel; it only summarizes the main conclusions concerning methanol. The problems of mass storage and transportation of hydrogen, capillary distribution, storage aboard vehicles and those concerning hydrogen thermal engines and hydrogen fuel cells are investigated. The different ways of using hydrogen, either compressed or liquefied or combined in hydrides, are taken into account. Energy and economic balance sheets lead to the conclusion that hydrogen internal combustion engines cannot compete with gasoline engines with regard to primary energy consumption and fuel cost. On the contrary, a hydrogen fuel cell, thanks to its high efficiency, provides for appreciable energy saving and leads to a fuel expense of the same order of magnitude as premium gasoline in a urban vehicle. With regard to methanol, it appears that the use of the 15% methanol gasoline mixture is the best solution with methanol produced in a local unit and delivered to the service-station successively by waterway barge and trailer.

44461 Study of special thermal and chemical uses of hydrogen. Pottier, J.; Marque, D.; Tellier, C. pp 531-543 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

The study is a survey of the special thermal and chemical industrial uses of hydrogen in France, with some consideration on future developments. The corresponding annual consumption of approximately 500 million m3 (n) covers the following sectors and appliances [annual consumption in million m3 (n)]: hydrogenation of plant and animal fats (2.5); hydrogenation in chemical industry (nylon, anilin, polyethylene); pharmaceutics, and mineral industry (H_2O_2, ClH, BrH) (450.10^6 m3/yr); glass industry - float glass protection (2.4); production of synthetic precious stones in high temperature ovens; (20) metallurgy for powder sintering, reduction of Mo, W, and U compounds, and mainly for controlled atmospheres for thermal treatment of alloys (21); welding (oxhydric or atomic hydrogen torch); production of silicon crystals for Electronic Industry (2.5); cooling fluid for Power Alternators (0.2); and fuel for spatial propulser tests (0.8). These uses may be compared to the annual hydrogen consumption for basic chemical industry in France which amounts to 9000 million m3 (n). That is 6000 for ammonia synthesis, 1500 for refining industry, 675 for methanol synthesis and 260 for oxo synthesis. Except for the welding sector and especially the motor fuel sector it does not appear that the development of pipe

network hydrogen distribution should develop large special uses. There may be some opportunities for new appliances, or for converting existing processes to hydrogen uses. Such a complex study has not been taken up and, furthermore, no industrial consulted during the survey has given interest to such new developments.

PROPERTIES

REFER ALSO TO CITATION(S) 44457

44462 Optimization of steels likely to be subjected to hydrogen action. Bretin, L.; Zmudzinski, C.; Toitot, M. (Creusot-Loire Metallurgical Research Center, Le Creusot, France). pp 427-446 of Seminar on hydrogen as an energy vector: its production, use and transportation. Luxembourg; Commission of the European Communities (1978). (In French)

From Seminar on hydrogen as an energy vector: its production, use and transportation; Brussels, Belgium (3 Oct 1978).

To contribute to the search for new sources of energy, on account of the ever increasing needs throughout the world, whereas the sources currently worked out tend to get exhausted, a request for bids was issued by the Commission of the European Communities in 1975 to stimulate investigations on the concept Production and Uses of Hydrogen, such gas being a possible promising alternate source. CREUSOT-LOIRE Metallurgical Research Center of Le Creusot have offered their contribution to this study within their scope of work, that is to say, the search for steels likely to stand safely and reliably in the presence of hydrogen. The grades of steels presently investigated have been selected in such a manner as to take into account their various potential uses; they include a steel for cold applications - 3% nickel steel, a steel for large-size pipelines - API X70 steel, two relatively high tensile steels for applications at relatively elevated temperatures - 20 CND 10 steel - or at elevated temperatures - 25 CD 12 steel. The tests carried out so far in compliance with our various laboratory methods, chiefly of the qualification type, showed that the steels selected should be suitable for the intended purpose; more sophisticated tests such as the test on rupture mechanics in hydrogen gas, or long-duration tests such as the delayed rupture test or the fatigue test in a hydrogen environment, should allow to confirm or deny the early conclusions.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44454

OTHER SYNTHETIC AND NATURAL FUELS

PROPERTIES

REFER ALSO TO CITATION(S) 44289

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 44211, 44213, 44226

44463 (N—78-29581) **Stage and development possibilities of the Fischer-Tropsch-synthesis for the production of primary chemicals and feedstocks.** Frohning, D.; Koelbel, H.; Rottig, W.; Schnur, F.; Schulz, H. (Ruhrchemie, A.G., Oberhausen (Germany, F.R.)). Dec 1977. 103p. NTIS PC A06/MF A01.

The manufacture of chemical feedstocks from synthesis gas via the modified Fischer-Tropsch Synthesis is being studied. The aim is the development of catalysts which allow, with improved selectivity, a direct conversion of carbon monoxide with hydrogen to short chain olefins (C2 to C4) and/or naphtha for chemical use. The possible modifications of known process steps and catalysts are summarised in this study. The stage of development and the flexibility of the gasphase-fixed bed-entrained fluidised bed and the liquid phase-process are compared with one another with regard to present technical and economic demands. From this comparison, the synthesis of ethylene and propylene based on German brown coal, using conventional gasification and production technologies, is economic when the selectivity is approx. 50%.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 44469, 44535, 44536, 44537, 44538, 44539

44464 (NP—23700) **Current awareness bulletin, March—April 1978.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). Jun 1978. 105p. Dep. NTIS (US Sales Only), PC A06/MF A01.

An annotated bibliography is presented on the use of animal wastes, crop residues, domestic and urban wastes, and forestry products as a fuel source and on methods for the conversion to fuel. (JSR)

44465 Pilot plant gasification test on biomass fuels: interim report. Goss, J.R. Sacramento, CA; California Energy Commission (1979). 76p. (NP—23813).

This interim report contains the preliminary results of the demonstration of the California Energy Commission's biomass gasifier. The gasifier, a scaled-up version of Swedish down-draft gasifiers, is capable of producing 8 million Btu of gas per hour from agricultural and forestry residues. During the demonstration the gasifier operated over 500 hours which included a continuous run of 330 hours. The gas from the gasifier was used in three applications. It was burned in a boiler to produce steam, burned in a low-Btu burner to produce heated air, and burned in a 60 KW diesel engine to generate electricity. This report describes the demonstration, and contains data on the operating characteristics, environmental impacts, and equipment costs of the gasifier system. This project thoroughly demonstrated the technical feasibility and requirements of firing steam boilers with low-Btu gas from a gasifier fueled with wood chips. The design, construction cost, and operational information obtained in this project should be used to guide the successful commercialization of biomass gasifiers to provide alternate fuel sources for existing steam boilers fired with natural gas or fuel oil.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 45095, 45097, 45098, 45100, 45102

PROPERTIES

REFER ALSO TO CITATION(S) 44289, 44460, 45096

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 44211, 44213, 44458

44466 (PB—288318) **Methanol synthesis: catalysts and mechanism.** Klier, K.; Herman, R.G.; Kobylinski, T.P. (Lehigh Univ., Bethlehem, PA (USA). Sinclair Lab.; Gulf Research and Development Co., Pittsburgh, PA (USA). Process Research Div.). 26 Apr 1977. 24p. NTIS PC A02/MF A01.

The mechanism of methanol synthesis over the Cu/ZnO/Cr2O3 and Cu/ZnO/Al2O3 catalysts is discussed in conjunction with the preparation, phase composition, surface area and pore size distribution of the composite catalyst, and with the catalytic activity of the individual components. It is demonstrated that, although the catalysts contain a large amount of metallic copper, the copper metal alone is not an active phase. Two kinds of promotion of zinc oxide by copper is discussed, one by Cu(I) ions diffusing into the ZnO and increasing its chemisorptive activity toward CO, and another by possible long-range electronic effects stemming from the work function difference between Cu and ZnO and increasing the rate of hydride formation at the ZnO surface. Detailed investigation by STEM of the catalyst morphology reveals the ZnO to be present as hexagonal platelets with the (0001) wurtzite basal planes exposed to the reaction mixture, and X-ray fluorescence analysis shows copper and zinc to be present in a very fine interdispersion. On the basis of the available experimental evidence, it is concluded that the active catalyst is a solid solution of Cu(I) in ZnO supported by copper metal. The roles of Cr2O3 and Al2O3 are minor but interesting as they influence the composition of side products. The observed morphologic and chemical properties of the catalyst are of significance in understanding the thermal instability and limited sulfur tolerance of this catalyst.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 44464, 44535, 44536, 44537, 44538, 44539

44467 (COO—4298-1) **Conversion of biomass from agriculture into useful products. Final report.** Tsao, G.T. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 31 Jul 1978. Contract EG-77-S-02-4298. 37p. Dep. NTIS, PC A03/MF A01.

The fermentation of the pentoses produced by the hydrolysis of hemicelluloses either to 2,3-butanediol by Klebsiella pneumoniae or to a mixture of 2,3-butanediol and ethanol by Aeromonas hydrophilia was studied to develop optimum conditions for the Klebsiella fermentation, confirm the xylose fermentation by Aeromona hydrophilia, and to study the growth of these microbes on pentoses and uronic acids and on actual hemicellulose hydrolyzates of corn stover. The results obtained in the solvent pretreatment in cellulose hydrolysis are reported. The solvents used were Cadoxen (solution of 5 to 7% cadmium oxide in 28% aqueous ethylene diamine), CMCS (an aqueous solution of 17% sodium tartrate, 6.6% ferric chloride, 7.8% caustic, and 6.2% sodium sulfite), and concentrated sulfuric acid. Almost quantitative yields of glucose can be obtained from the reprecipitated cellulose by enzymatic hydrolysis. (JSR)

44468 (PB—284742) **Parameters for legislative consideration of bioconversion technologies.** Abeles, T.P.; King, J.R. (Minnesota Legislature Science and Technology Project, St. Paul (USA)). Feb 1978. 45p. NTIS PC A03/MF A01.

Included in this report and the minibrief which accompanies it are conclusions and recommendations that evolved from the examination of various models of biomass production of nonpetroleum fuels. This included the Nebraska Grain and Alcohol Program. It was determined that it was neither economically nor energetically wise at this time for Minnesota to commit itself to a gasohol program modelled after Nebraska's program. Instead of adopting the single-source, large-scale Nebraska model, it was concluded that Minnesota should do the pilot and demonstration plants for the production of ethanol on the small scale (farm or local co-op size), and encourage the utilization of a variety of feedstocks such as sugar beets, grains, and cellulosic residues.

44469 (SAN—0155-T4) **Mission analysis for the Federal Fuels from Biomass Program. Volume VI. Mission addendum. Final report.** Jones, J.L.; Kohan, S.M.; Semrau, . (SRI International, Menlo Park, CA (USA)). Jan 1979. Contract EY-76-C-03-0115-131. 115p. Dep. NTIS, PC A06/MF A01.

This volume contains the results of additional evaluation work requested by the Department of Energy after initiation of the original Mission Analysis Project contract. The descriptive material can be categorized as biochemical and thermochemical mission analyses and in general includes process descriptions, energy balances, material balances, and economic summaries. The volume consists of four main sections: ethanol from the acid hydrolysis of corn stover by the Tsao—Purdue Process; the Tilby Sugarcane Separation Process; the extraction of hydrocarbon liquids from Euphorbia-type plants; and the production of IBG from wood. The processes vary considerably in their level of development and with the exception of the Tilby Sugarcane Separation process all are in early stages of testing. Therefore, they were evaluated on the basis of extremely limited laboratory or pilot plant information. As a result it was necessary for the SRI staff to conceptualize much of the process design used in the evaluations. Accordingly, the results shown are subject to revision as additional process information is developed. The economic design bases used in preparing the investment and operating cost data contained in Sections II through V are shown in the appendix.

PREPARATION

REFER ALSO TO CITATION(S) 44535, 44536, 44537, 44538, 44539

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 44464, 44535, 44536, 44537, 44538, 44539

HYDRO ENERGY

SITE GEOLOGY AND METEOROLOGY

44470 (DOE/ID/1768—1) **Reconnaissance feasibility study hydroelectric potential on Lowell Creek.** (CH2M Hill, Anchorage, AK (USA)). Mar 1979. Contract EW-78-F-07-1768. 41p. Dep. NTIS, PC A03/MF A01.

The feasibility of hydroelectric power development on Lowell Creek near Seward was investigated at a reconnaissance level. The study was conducted because the physical characteristics of the creek and surrounding terrain initially appeared suitable for hydroelectric power. The creek has a steep gradient (about 400 feet per mile), is fed from a large snowfield, and has two significant drops. One drop is formed by the presence of a dam that was constructed to divert the creek through a mountain and around the town. The second drop of about 65 feet is at the termination of the diversion tunnel. Three alternative sites for hydroelectric plants were considered, one each at the two drops and one farther upstream at the site of an old abandoned intake and valve house. Two of the sites were considered for 25-kW plants and one for a 100-kW plant. All were limited to a low head, less than 66 feet. Use of an existing dam and tunnel and an abandoned diversion dam and valve house was considered as part of the project alternatives. None of the three alternatives approaches feasibility at this time. Major influencing factors are the high cost of energy at over 13 cents per kWh, the winter freezeup resulting in plant shutdown from November to April, and a large amount of rock sediment carried by the stream and requiring expensive intake structures to skim off the rocks. The most promising alternative (alternative C), which would have a capacity of 250 kW and would produce about 800,000 kWh per year, would fill less than 5% of the city's present energy needs. The plant would cost nearly $1 million and produce energy at about 137 miles per kWh. This alternative is the best of the three from the standpoint of its lower cost, best access via existing all-weather road, least exposure to avalanche and rockslides, and proximity to existing powerlines.

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 44470

44471 (DOE/RA—23-216.00.0-02) **Fundamental economic issues in the development of small-scale hydro.** Brown, P.W.; Ringo, M. (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). 15 Mar 1979. 31p. Dep. NTIS, PC A03/MF A01.

The paper raises and, in part, addresses some basic economic issues involved in the development of Small-Scale Hydroelectric power (SSH). The analysis is based on literature reviews, case studies, on-site visits, and particularly information from the Franklin Pierce - Thayer project. Broadly stated, economic analysis to date suggests that legal and regulatory constraints are the major obstacles for the slow development of SSH development. The technology is available. This analysis is addressed toward presenting the economic picture of a hydro site as if it were a typical small business. The discussion is broken down into four parts, namely: costs, supply, demand, and profitability. (MCW)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44866, 45381, 45401

44472 (PB—288116) **The politics of hydroelectric power in alaska: rampart and devil canyon. a case study. Completion report.** Naske, C.M.; Hunt, W.R. (Alaska Univ., College (USA). Inst. of Water Resources). Jan 1978. Contract DI-14-34-0001-70003-. 65p. NTIS PC A04/MF A01.

The decision making process involved in development of hydroelectric projects in Alaska is reviewed. Three projects are discussed: Eklutna, which is presently functioning; Rampart, which was not constructed; and Devil Canyon, which is still being planned. Although all three projects have different locations and goals, their histories reveal all the essential elements involved in hydroelectric power construction projects. The roles of several government agencies and the public were assessed. Factors in the power debate, such as environmentalist position, political support, newspaper coverage and sponsorship, and official commitments were examined.

SOLAR ENERGY

44473 (SERI/TR—54-066) **Annual review of solar energy. Period of review: 1977.** (Solar Energy Research Inst., Golden, CO (USA)). Oct 1978. Contract EG-77-C-01-4-4042. 179p. Dep. NTIS, PC A09/MF A01.

A general review of national solar energy programs is provided. An executive summary and a brief history of the Federal solar energy program are presented. The issues and implications of the National Energy Plan that relate to solar energy development ae discussed. An overview is provided of the present Federal solar energy program, including the activities of several Federal agencies outside the Department of Energy. Some of the non-Federal solar energy programs ae reviewed, including international programs in which the U.S. has some role, programs of state and local governments, college and university programs, the work of private industry, and individual and small scale activities. A synposis of the major categories of solar technology is provided. Each chapter discusses a particular technology area and includes a basic technological description; a summary of the goals and activities of the Federal R & D program for the technology; significant events and development of the past year; and a brief overview of problems, uncertainties, and dissenting views. Three appendices include a synopsis of major energy events of 1977; a glossary of technical terms, abbreviations, and acronyms, and a table of conversion factors. (MHR)

44474 (TAC-STPG—78-004) **Solar thermal power generation: a bibliography with abstracts. Quarterly update, October—December 1978.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Feb 1979. 107p. Univ. of New Mexico, Albuquerque.

This bibliography covers the following areas: energy overviews, solar overviews, conservation, economics and law, thermal power, thermionic and thermoelectric, ocean, wind power, biomass and photochemical, and large photovoltaics. Both an author index and a keyword index are provided. (MHR)

RESOURCES AND AVAILABILITY

44475 (SOLAR/0009—78/27) **Environmental data for selected solar energy sites.** (International Business Machines Corp., Huntsville, AL (USA)). 30 Jun 1978. Contract EG-77-C-01-4049. 54p. Dep. NTIS, PC A04/MF A01.

Certain environmental data are collected at each active site which is part of the National Solar Data Network. The data includes total solar insolation and outside ambient temperature for all sites. For some sites, diffuse solar insolation and wind speed/direction are recorded and, for solar systems which supply air conditioning, relative humidity data is sometimes obtained. This report summarizes the data by climatological zones as identified in the zone map. Total solar insolation data is measured at each site with an Eppley Laboratories Model PSP precision pyranometer mounted in the plane of the collector array. Diffuse insolation is measured by the addition of an identical instrument equipped with a shadow band to block our the direct beam radiation for those sites with concentrating type collectors. Ambient temperature is measured with a Minco Products S53P Resistance Temperature Detector (RTD) mounted in a Weather Measure IS4 Radiation Shield. Wind speed and direction are measured at selected sites where the wind can have significant effects on collector losses, as is the case with concentrating collectors. Relative humidity is measured, at selected sites, using a Weather Measure Corporation Model HM-111P relative humidity sensor.

ECONOMICS

REFER ALSO TO CITATION(S) 44606

44476 **Solar heating and employment in Canada.** Victor, P.A.; Hathaway, G.; Lubek, J. Toronto, Canada; Middleton Associates (1979). 168p. (ER—79-1). Energy, Mines and Resources Canada, Ottawa, Canada.

Seven representative heating systems and applications are described in detail. The systems include water heating, space and water heating and pool heating systems for single family dwellings; a space and water heating system for multi-family dwellings; water heating and space heating systems for commercial applications. In all cases, the representative systems use flat plate collectors and a liquid heat transfer medium. Estimates of the heat supplied, as well as the direct labor and material requirements are provided for each representative system. These estimates, based on a review of the technical literature and on information supplied by manufacturers and contractors, are used as input data to an employment impact simulation model developed for this study. The model allows an examination of the employment and energy implications of various assumptions about the future of solar heating in Canada. It distinguishes among rates of implementation for each representative solar heating system in the five major Canadian regions: the Maritimes, Quebec, Ontario, the Prairies, and British Columbia. Output from the model includes estimates for each region to the year 2000 of the energy supplied by solar heating, the cumulative area of installed collectors, the amount of labor by type employed directly in the solar heating industry, and the amount of indirect labor. The employment implications of exporting solar collectors are also examined. Assumptions regarding implementation rates, the location of the solar industry in Canada and the reliance on imports are detailed. The results obtained from the model on the basis of these assumptions are also provided.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 45364

44477 **Lgislative and regulatory issues in the solar industry.** Belanger, J.A. (State of Connecticut, Office of Policy and Management, Hartford). pp 463-466 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Issues involved in legisltive and regulatory programs at all levels of government that relate to pricing, codes, and consumer protection are reviewed. (MHR)

44478 (TID—29406) **Program EIS's in the solar energy development context: problems and proposed solutions. Final draft on task assignment No. 3.** Enk, G.A.; Lundquist, T. (Institute on Man and Science, Rensselaerville, NY (USA). Dept. of Economic and Environmental Studies). 18 Feb 1977. Contract EX-76-C-01-2333. 124p. Dep. NTIS, PC A06/MF A01.

The Solar Energy Division's environmental duties and options regarding its Research, Development and Demonstration (R, D and D) Program are reviewed. Specifically, this study concentrates on the potential need for a Program Environmental Impact Statement (Program EIS) under the National Environmental Policy Act (NEPA). The analysis, based on a review of judicial decisions, administrative guidelines and academic commentary, concludes that no comprehensive program EIS is required as a matter of law or public policy. Instead, it recommends that the Solar Energy Division pursue and document environmental information through a series of program unit-focused Environmental Impact Assessments (EIA's) which offer more flexibility in analysis. The extensive and complicated legally oriented aspects of this study are presented.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 44541, 44542, 44614, 44625, 44640, 44648, 45107, 45110

44479 (AD-A—060640) **Optical properties of semiconductors: solar cell materials. Final report 15 May—15 Aug 1978.** Shiles, E. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Physics). 15 Aug 1978. 78p. NTIS PC A05/MF A01.

The optical properties of the semiconductors silicon and gallium arsenide have been examined by a Kramers-Kronig analysis of the available experimental measurements of the optical constants (reflectivity, extinction coefficient, index of refraction, and dielectric function) for these materials. The results include the full range of optical electronic excitations, from infrared through X-rays, and have been examined by the evaluation of various sum rules. The sum rules are well satisfied by the resulting silicon data, and the results are consistent with the various experimental measurements. There is some question concerning the data in the region of band-to-band transitions (visible and ultra-violet); the resolution must await further experimental measurements of reflectivity and/or dielectric function in this spectral range. The silicon work constitutes the first part of this report. For gallium arsenide, the sum rules analysis indicates that the available experimental measurements of the absorption of gallium and arsenic may be too small in the X-ray region at energies less than the onset of L-shell core electron excitations. Also the data is incomplete in the region just above the L-shell threshold. Comparison of the final results with various experimental measurements also indicate that the available normal-incidence reflectivity data in the region of band-to-band transitions may be inaccurate (values too small). The gallium arsenide calculation and the above mentioned problems are described in the second part of this report. The work is continuing, in an attempt to locate more experimental data and to define more closely the spectral regions where the presently available data is inaccurate.

44480 (CONF-761168—(Summ.), pp 15-37) **Basic solar energy science in thin-film photovoltaic conversion.** Griffith, R.W. (Argonne National Laboratory, IL). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Materials requirements for a very large array of photovoltaic cells are discussed. Some examples of thin film photocells are discussed as a reference frame for materials problems. These examples include various types of polycrystalline semiconductors, amorphous silicon photovoltaics, and organic solar cells. (WHK)

44481 (CONF-761168—(Summ.), pp 71-75) **Semiconductor films.** Bachmann, K.J.; Shay, J.L.; Bettini, M.; Buehler, E.; Wagner, S. (Bell Laboratories, Murray Hill and Holmdel, NJ). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Areas of fundamental research on semiconductor films that are likely to benefit applied work concerning polycrystalline solar cells are defined. Areas discussed include the comprehensive evaluation of grain boundaries, the effect of impurities in solar cells, the development of new materials and processes, and the field of electrochemical solar cells. (WHK)

44482 (CONF-790442—12) **Thermal stability and decomposition kinetics of amorphous hydrogenated films.** McMillan, J.A.; Peterson, E.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

The kinetics of decomposition of the $= SiH_2$ and identical with SiH centers in amorphous hydrogenated silicon films have been studied by thermomanometric analysis. The methods of preparation and analysis are described. Experimental values of the enthalpy and entropy of activation are given in both cases. Tentative reaction mechanisms are proposed on the basis of an interpretation of the results.

44483 **Ion-implanted solar cells.** Pai, Y.P. College Park, MD; Univ. of Maryland (1978). 123p. University Microfilms Order No. 79-08,859.

Thesis (Ph. D.).

An ion-implanted solar cell has been made by implanting low energy arsenic ions to the surface of a p-type silicon substrate. The ion-implantation technique offers the advantages of a better dosage control, uniformity, and reproducibility over the conventional diffusion method. A solar cell thus formed can be either a Schottky barrier or a junction, depending on the implantation dosage. The main contribution of this research lies in presenting a general analysis for the ion-implanted solar cell, which in the extreme case can be applied to either the MIS Schottky cell or the pn junction cell. This analysis has been done either analytically by making some approximations in the formulation or numerically by solving the one-dimensional transport equations with the best available structural and material parameters as input data. Additional experimental work has been done in supporting our analysis. And finally, some of the important solar cell parameters have also been characterized in our study.

44484 (DOE/ET—0019/2) **Photovoltaic systems. Program summary.** (Department of Energy, Washington, DC (USA). Office of Solar, Geothermal, Electric and Storage Systems). Dec 1978. 366p. Dep. NTIS, PC A16/MF A01.

Each of the Department of Energy's Photovoltaic Systems Program projects funded and/or in existence during fiscal year 1978 (October 1, 1977 through September 30, 1978) are described. The project sheets list the contractor, principal investigator, and contract number and funding and summarize the programs and status. The program is divided into various elements: program assessment and integration, research and advanced development, technology development, system definition and development, system application experiments, and standards and performance criteria. (WHK)

44485 (DOE/JPL/1012—77/6) **Compatibility studies of various refractory materials in contact with molten silicon.** O'Donnell, T.; Leipold, M.; Hagan, M. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Mar 1978. Contract EX-76-A-29-1012. 120p. (JPL-PUB—78-18). Dep. NTIS, PC A06/MF A01.

The production of low cost, efficient solar cells for terrestrial electric power generation involves the manipulation of molten silicon with a present need for noncontaminating high-temperature refractories to be used as containment vessels, ribbon-production dies and dip-coated substrates. Studies were conducted on the wetting behavior and chemical/physical interactions between molten silicon and various refractory materials.

44486 (DOE/JPL/1012—78/2) **LSA Low-Cost Solar Array Project. Project quarterly report No. 6, July—September 1977.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1977. Contract EX-76-A-29-1012. 135p. (JPL-PUBL—78-83). Dep. NTIS, PC A07/MF A01.

The activities of the Low-Cost Silicon Solar Array Project during the period July through September, 1977, are described. The LSSA Project is assigned responsibility for advancing silicon solar array technology while encouraging industry to reduce the price of arrays to a level at which photovoltaic electric power systems will be competitive with more conventional power sources early in the next decade. Set forth here are the goals and plans with which the Project intends to accomplish this, and the progress that was made during the quarter. The Project objective is to develop the national capability to produce low-cost, long-life photovoltaic arrays at a rate greater than 500 megawatts per year and a price of less than $500 per kilowatt peak by 1986. The array performance goals include an efficiency greater than 10% and an operating lifetime in excess of 20 years.

44487 (DOE/JPL/954356—7A) **Silicon on ceramic process. Silicon sheet growth and device development for the large-area silicon sheet and cell development tasks of the low-cost solar array project. Quarterly report No. 10, September 30—December 31, 1978.** Chapman, P.W.; Zook, J.D.; Heaps, J.D.; Pickering, C.; Grung, B.L.; Koepke, B.; Schuldt, S.B. (Honeywell Corporate Material Sciences Center, Bloomington, MN (USA)). 31 Jan 1979. Contract NAS-7-100-954356. 62p. Dep. NTIS, PC A04/MF A01.

The objective of this research program is to investigate the technical and economic, feasibility of producing solar-cell-quality sheet silicon. This program is directed at coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. Also, work directed toward the solution of unique cell processing/design problems encountered within the silicon-on-ceramic (SOC) material due to its intimate contact with the ceramic substrate is described. Significant progress was demonstrated in several areas: (1) the continuous (SCIM or Silicon Coating by an Inverted Meniscus) coater succeeded in producing small-area coatings exhibiting unidirectional solidification and substantial grain size; (2) the experimental dip coater was put into operation and succeeded in producing thick, $> 500\ \mu m$, dendritic layers at coating speeds of 0.2 to 0.3 cm/sec; and (3) a standard procedure for producing total-area SOC solar cells was developed using slotted ceramic substrates. The best conversion efficiency performance to date is 9.6 percent (antireflective-coated AM1) on a 4-cm^2 total-area cell. Results and accomplishments during the quarter are discussed.

44488 (DOE/JPL/954363—8) **Phase I of the automated array assembly task of the low cost silicon solar array project. Final report.** Pryor, R.A.; Grenon, L.A.; Coleman, M.G. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). Jan 1978. Contract NAS-7-100-954363. 299p. Dep. NTIS, PC A13/MF A01.

The solar cell which is considered for these studies is a silicon solar cell with a shallow ($<1\mu$) metallurgical P-N junction, a back surface high-low junction (enhancement layer), and patterned front and full back contact metallizations. The cell also has an antireflection coating covering a texture-etched front surface. Detailed results of a study of process variables and solar cell variables are presented. Emphasis is on identifying interactions between variables and their effects upon control ranges of the variables. Also, the results of a detailed cost analysis for manufacturing solar cells are reported. This cost analysis includes a sensitivity analysis of a number of key cost factors. (WHK)

44489 (DOE/JPL/954372—6) **Chemical vapor deposition growth. Final report, December 29, 1975—August 31, 1977.** Ruth, R.P.; Campbell, A.G.; Kenty, J.L.; Shaw, G.L.; Yang, J.J.; Manasevit, H.M.; Johnson, R.E.; Moudy, L.A.; Simpson, W.I. (Rockwell International Corp., Anaheim, CA (USA). Electronic Devices Div.). Oct 1978. Contract NAS-7-100-954372. 257p. Dep. NTIS, PC A12/MF A01.

The objective of this study was to investigate and develop chemical vapor deposition (CVD) techniques for the growth of large areas of Si sheet on inexpensive substrate materials, with resulting sheet properties suitable for fabricating solar cells that would meet the technical goals of the Low Cost Silicon Solar Array (LSSA) Project. The results of 20 months of experimental work are summarized. The program involved six main technical tasks: (1) modification and test of an existing vertical-chamber CVD reactor system; (2) identification and/or development of suitable inexpensive substrate materials; (3) experimental investigation of CVD process parameters using various candidate substrate materials; (4) preparation of Si sheet samples for various special studies, including solar cell fabrication; (5) evaluation of the properties of the Si sheet material produced by the CVD process; and (6) fabrication and evaluation of experimental solar cell structures by OCLI, using impurity diffusion and other standard and near-standard processing techniques, supplemented late in the program by the in situ CVD growth of $n^+/p/p^+$

sheet structures subsquently processed into experimental cells. The principal CVD process used was silane (SiH_4) pyrolysis, although a few experiments were done with the dichlorosilane (SiH_2Cl_2) process for Si deposition. The evaluation of various possiblesubstrate materials, the CVD parameter investigations, and the experimental solar cell fabrication and characterization are described in considerable detail. Specific conclusions of the work are discussed, and recommendations for continued investigations in certain areas are given. (WHK)

44490 (DOE/JPL/954777—6) **Silicon halide—alkali metal flames as a source of solar grade silicon. Sixth quarterly report.** Olson, D.B.; Miller, W.J. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Jan 1979. Contract NAS-7-100-954777. 15p. (AeroChem-TN—201). Dep. NTIS, PC A02/MF A01.

This program is designed to demonstrate the feasibility of using alkali metal—silicon halide diffusion flames to produce solar-grade silicon in large quantities and at low cost. Prior work has shown that these flames are stable and that relatively high purity silicon can be produced using Na + $SiCl_4$ flames. Silicon of similar purity is obtained from Na + SiF_4 flames although yields are lower and product separation and collection are less thermochemically favored. Continuous separation of silicon from the byproduct alkali salt has been demonstrated in a heated graphite reactor. During the current reporting period the process has been scaled up to reduce heat losses and to produce larger samples of silicon. Reagent delivery systems, scaled by a factor of 25, have been built and operated at a production rate of 0.5 kg Si h^{-1}. Very rapid rector heating rates are observed with wall temperatures reaching > 2000 K. Heat release parameters were measured using a cooled stainless steel reactor tube. External heat input is not required. A new reactor has been designed based on these measurements and construction is underway.

44491 (DOE/JPL/954833—1) **Feasibility study of solar dome encapsulation of photovoltaic arrays. Low-Cost Solar Array Project, engineering area. Phase I: final report.** Zimmerman, D.K. (Boeing Engineering and Construction Co., Seattle, WA (USA)). Dec 1978. Contract NAS-7-100-954833. 175p. Dep. NTIS, PC A08/MF A01.

This report describes a study which investigated the potential technical and economic advantages of using air-supported plastic enclosures to protect flat plate photovoltaic arrays. Conceptual designs for a fixed, latitude-tilt array and a fully tracking array were defined. Another program provided much of the design and supporting analyses for the tracking array. Detailed wind loads and strength analyses were performed for the fixed array. Detailed thermal and power output analyses provided array performance for typical seasonal and extreme temperature conditions. Costs of each design as used in a 200 MWe central power station were defined from manufacturing and material cost estimates. The capital cost and cost of energy for the enclosed fixed-tilt array were lower than for the enclosed tracking array. The enclosed fixed-tilt array capital investment was 38% less, and the levelized bus bar energy cost was 26% less than costs for a conventional, glass-encapsulated array design. The predicted energy cost for the enclosed fixed array was 79 mills/kW h for direct current delivered to the power conditioning units.

44492 (DOE/JPL/954847—3) **Phase 2 of the automated array assembly task of the low cost silicon solar array project. Technical quarterly report No. 3, April—June 1978.** Coleman, M.G.; Pastirik, E.M.; Pryor, R.A. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1978. Contract NAS-7-100-954847. 43p. Dep. NTIS, PC A03/MF A01.

The previously reported study on wax masking has been critically reviewed. This system is based upon a wax-solvent technique. Further studies have been performed on wax masking, and a melted wax application has been found preferable to the wax-solvent technology. Photoresponse data have been obtained for ion implanted phosphorous and arsenic into p-type test wafers as well as boron into n-type test wafers. The resulting cells, corrected for texture etching and antireflection coat addition, would be expected to perform as well as the best diffused cells in current production. Improvements have been made in the plated metallization process which is being developed under separate contract. The immersion layer deposited by a new plating chemistry is uniform and adherent, showing promise for improved yield and performance, and reduced cost. Texture etching technology advancements have been made, allowing the formation of smaller and more uniformly-sized textured peaks. This is done in a simple etching bath with no physical constraints. The smaller peaks have a very favorable impact upon other process steps, and can greatly reduce the incidence of handling-induced damage. These improvements are now being incorporated into the process sequence being developed on this program. A discussion of process verification is presented.

44493 (DOE/JPL/954876—5) **Development and evaluation of die and container materials. Fifth quarterly progress report, October 1—December 31, 1978.** Wills, R.R.; Niesz, D.E. (Battelle Columbus Labs., OH (USA)). 15 Jan 1979. Contract NAS-7-100-954876. 31p. Dep. NTIS, PC A03/MF A01.

X = 0.75 β' (a silicon aluminum oxynitride) and Sibeon (silicon beryllium oxynitride) are promising die materials. In sessile drop tests in contact with molten silicon, beryllium contamination was < 10 ppM and aluminum contamination 50 ppm. A shaping die of the Sialon material has been successfully fabricated and delivered to JPL. This X = 0.75 β' Sialon exhibits an almost constant wetting angle of 37 degrees. The dissolution of aluminum in molten silicon is influenced by the oxygen content of the molten silicon and the material should be used under inert atmosphere conditions with a suitable crucible material that does not affect the Sialon—silicon equilibrim. Dry milling studies for the preparation of Si_3N_4-Al_2O_3-AlN mixtures have been performed with butanol, acetic anhydride, oleic acid, and triethanolamine milling aids. Optimum mixing was achieved with 0.15 percent triethanolamine using a milling time of 8 hours. Preliminary evaluation of Sibeon materials indicates that they are more resistent to molten silicon attack than X = 0.75 β Sialon. Silicon contamination from the beryllium was less than aluminum contamination even though the aluminum impurity level in the Sibeon was only 450 to 1300 ppM. Work designed to produce an aluminum-free Sibeon is described.

44494 (DOE/JPL/954888—4) **Continuous Czochralski growth. Silicon sheet growth development of the large area silicon sheet task of the low cost silicon solar array project. First annual progress report, October 1, 1977—September 30, 1978.** Lane, R.L. (Kayex Corp., Rochester, NY (USA)). 1978. Contract NAS-7-100-954888. 52p. Dep. NTIS, PC A04/MF A01.

The primary objective of this work is to develop equipment and methods for the economic production of single crystal ingot material by the continuous Czochralski (CZ) process. Continuous CZ is defined for the purpose of this work as the growth of at least 100 kilograms of ingot from only one melt container. The approach to the project is to utilize a Hamco production CG2000 crystal grower suitably modified to grow large crystals and to permit periodic replenishment of the liquid. Key modifications were a vacuum tight isolation valve to separate the furnace chamber from the pull chamber for recharging, an automatic recharge mechanism, and an enlarged pull chamber to hold a supply of poly material. Other suitable modifications to permit the growth of crystals up to about 35 kilograms each included an optical diameter control system to allow crystals up to 12.5 cm to be grown, and a pull mechanism capable of supporting the large crystal to be grown. Furnace hot zone modifications were designed and built to accomodate 14-inch diameter crucibles having a melt capacity of about 40 kilograms. Progress is reported.

44495 (DOE/JPL/954899—6) **Industrialization study. Phase II final report.** (Gnostic Concepts, Inc., Menlo Park, CA (USA)). 1978. Contract NAS-7-100-954899. 134p. Dep. NTIS, PC A07/MF A01.

The program described is an element of the JPL analysis of the industrialization process for the photovoltaic venture. As part of this program, information concerning advanced photovoltaic technologies was collected. Emphasis was placed upon characterizing the present status of these advanced technologies and extracting their future potential capabilities. The ultimate objective was to establish a comparative framework within which selection could be made for government emphasis of high-potential advanced technologies. Areas covered in this report include the technical assessments of selected advanced technologies. Information collected was in the area of manufacturing process steps and their implications on cell performance, along with present and future expected performance characteristics. In addition, a summary of the technical and manufacturing barriers and a summary of other influences is provided. A comparative assessment of the advanced technology bases was also constructed. A rank ordering of the advanced technologies is provided. A final selection was made of those advanced photovoltaic technologies that have a high potential for industrialization prospects and an estimate of the timing of the possible readiness of these advanced technologies for technology development programs and industrialization. The study culminates in a set of recommended government actions concerning the various advanced technologies addressed.

44496 (DOE/JPL/955077—3) **Evaluation of the technical feasibility and effective cost of various wafer thicknesses for the manufacture of solar cells. First quarterly progress report, July 15—September 30, 1978.** (Solarex Corp., Rockville, MD (USA)). 1978. Contract NAS-7-100-955077. 28p. Dep. NTIS, PC A03/MF A01.

Three wafering demonstration runs have been completed on the Yasunaga wire saw. Wafer thickness/taper uniformity is excellent. Many small problems have been encountered with Yasunaga accessories, slowing the effort. A wafer characterization cycle has been defined and will be initiated during the next period.

44497 (DOE/JPL/955339—1) **Anti-reflection coatings on large area glass sheets. Quarterly technical report No. 1, January 29—**

March 31, 1979. Pastirik, E. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-955339. 12p. Dep. NTIS, PC A02/MF A01.

The ultimate goal of the project is the improvement of the efficiency of photovoltaic modules through increased transmission of light by the module cover. One method of increasing transmission is by reducing the reflection of light by the module cover, a reflection which accounts for a 4% loss of transmission for each coverglass-air interface. This study is intended to advance a known antireflection technology to the point where large area glass module covers can be treated to produce uniform, efficient, and durable antireflective films. The current progress is reported.

44498 (DOE/NASA/20485—79/2) **Method for correlating performance data of a terrestrial solar cell array.** Simon, F.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1979. 46p. (NASA-TM—79163). Dep. NTIS, PC A03/MF A01.

An analytical method is proposed for characterizing array power output, in the region of maximum power, as a function of environmental variables. The purpose of the correlation is to provide a way of evaluating the output of an array under environmental conditions that differ from those encountered during testing. Power data obtained at one location can be used to predict array performance at other locations.

44499 (N—78-29568) **Study of electronic properties in proton- and electron-irradiated GaAlAs and GaAs solar cell materials. Final report, 1 September 1977—31 August 1978.** Li, S.S. (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). 31 Aug 1978. 69p. NTIS PC A04/MF A01.

Diagnostical measurement techniques such as dark I-V, C-V, the thermally insulated capacitance, and the deep level transient spectroscopy methods were employed to study defect properties in the proton-irradiated n-GaAs materials. Defect energy levels, thermal emission rates, and capture cross sections of electrons as well as trap densities were deduced from these measurements and the results are presented. Correlations between the measured defect parameters and the dark I-V characteristics of the n-GaAs Schottky barrier diodes are also discussed. Defect energy levels (i.e., electron traps) determined are also compared with published data in order to identify their physical origins.

44500 (N—78-29585) **A theoretical analysis of the current-voltage characteristics of solar cells. Annual report.** Fang, R.C.Y.; Hauser, J.R. (North Carolina State Univ., Raleigh (USA). Solid State Electronics Lab.). Sep 1977. Contract NGR-34-002-195. 171p. NTIS PC A08/MF A01.

The correlation of theoretical and experimental data is discussed along with the development of a complete solar cell analysis. The dark current-voltage characteristics, and the parameters for solar cells are analyzed. The series resistance, and impurity gradient effects on solar cells were studied, the effects of nonuniformities on solar cell performance were analyzed.

44501 (N—78-33265) **Floating substrate process: Large-Area Silicon Sheet Task, Low-Cost Solar Array Project. Final report.** Garfinkel, M.; Hall, R.N. (General Electric Co., Schenectady, NY (USA)). 23 Jun 1978. Contract JPL-954350. 85p. NTIS PC A05/MF A01.

Supercooling of silicon-tin alloy melts was studied. Values as high as 78 C at 1100 C and 39 C at 1200 C were observed, corresponding to supersaturation parameter values 0.025 and 0.053 at 1050 C and 1150 C, respectively. The interaction of tin with silane gas streams was investigated over the temperature range 1000 to 1200 C. Single-pass conversion efficiencies exceeding 30% were obtained. The growth habit of spontaneously-nucleated surface growth was determined to be consistent with dendritic and web growth from singly-twinned triangular nucleii. Surface growth of interlocking silicon crystals, thin enough to follow the surface of the liquid and with growth velocity as high as 5 mm/min, was obtained. Large area single-crystal growth along the melt surface was not achieved. Small single-crystal surface growth was obtained which did not propagate beyond a few millimeters.

44502 (N—78-33533) **Module/array interface study. Final report.** (Bechtel International Corp., San Francisco, CA (USA)). Aug 1978. Contract JPL-954698. 128p. NTIS PC A07/MF A01.

Several aspects of module design are evaluated, including glass superstrate and metal substrate module configurations, the potential for hail damage, light absorption in glass superstrates, the economics of glass selection, and electrical design. Also, three alternate glass superstrate module configurations are evaluated by means of finite element computer analyses. Two panel sizes, 1.2 by 2.4 m (4 by 8 ft) and 2.4 by 4.8 m are used to support three module sizes, 0.6 by 1.2 m, 1.2 by 1.2 m, and 1.2 by 2.4 m, for design loadings of + or - 1.7 kPa, + or - 2.4 kPa, and + or - 3.6 kPa. Designs and cost estimates are presented for twenty panel types and nine array configurations at each of the three design loadings. Structural cost sensitivities of combined array configurations and panel cases are presented.

44503 (N—78-33534) **Terrestrial central station array life-cycle analysis support study. Final report.** (Bechtel Corp., San Francisco, CA (USA)). Aug 1978. Contract JPL-954848. 211p. NTIS PC A10/MF A01.

Plant elements evaluated included designs for module, panel and array structures, as well as balance-of-plant systems. Installation and maintenance procedures and the impact of site environment were also evaluated. In terms of the cost of energy produced, the horizontal array configuration was found to be less expensive than the tandem array at latitudes less than 40 deg. Both of these configurations are less expensive than the rack design. However, the costs of energy for all three configurations are within approximately 10 percent of each other. For flat plate panels, the seasonally adjusted and tracking array configurations are not economically attractive when compared to the three other designs. Balance-of-plant costs are approximately equal to (goal) module costs. The array structures and foundations are the most expensive items in the balance-of-plant costs.

44504 (N—78-33535) **Evaluation available encapsulation materials for low-cost long-life silicon photovoltaic arrays. Final report.** Carmichael, D.C.; Gaines, G.B.; Noel, G.T.; Sliemers, F.A.; Nance, G.P. (Battelle Columbus Labs., OH (USA)). 30 Jun 1978. Contract JPL-954328. 110p. NTIS PC A06/MF A01.

Experimental evaluation of selected encapsulation designs and materials based on an earlier study which have potential for use in low cost, long-life photovoltaic arrays are reported. The performance of candidate materials and encapsulated cells were evaluated principally for three types of encapsulation designs based on their potentially low materials and processing costs: (1) polymeric coatings, transparent conformal coatings over the cell with a structural-support substrate; (2) polymeric film lamination, cells laminated between two films or sheets of polymeric materials; and (3) glass-covered systems, cells adhesively bonded to a glass cover (superstrate) with a polymeric pottant and a glass or other substrate material. Several other design types, including those utilizing polymer sheet and pottant materials, were also included in the investigation.

44505 (NMEI—21) **Dielectric development for GaAs solar cells.** Grannemann, W.W.; Su, C.S. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Jan 1979. 24p. New Mexico State Univ., Las Cruces.

Gallium phosphate passivation was used on gallium arsenide. This type of passivation was studied for use on gallium arsenide solar cells. The gallium phosphate has good antireflective characteristics when applied to gallium arsenide. Metal—gallium phosphate—gallium arsenide capacitors were constructed so that capacitance versus voltage measurement could be made. Interface state densities were determined from the c-v curves. The fast interface state densities were excellent and the corresponding surface recombination velocities should be low. This should give a major improvement in gallium arsenide solar cell efficiency using this passivation layer.

44506 (NTIS/PS—78/1213) **Cadmium sulfide solar cells (citations from the NTIS data base). Report for 1964-November 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 266p. NTIS PC N01/MF N01.

Citations from Federally-funded research cover cadmium sulfide solar cell theory, design, development, fabrication, and degradation. Studies include junctions with thin films of copper sulfide, selenides, and tellurides. The performance, testing, analysis, efficiency, and costs of these cells are covered. (This updated bibliography contains 261 abstracts, 17 of which are new entries to the previous edition.)

44507 (NTIS/PS—78/1214) **Cadmium sulfide solar cells (citations from the Engineering Index Data Base). Report for 1970-November 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 176p. NTIS PC N01/MF N01.

Worldwide research on cadmium sulfide solar cell design, development, fabrication, heterojunctions, doping, and performance are cited in this bibliography. Studies on defects, protective coatings, and arrays are included. Thin films of copper indium selenide, copper sulfide, indium phosphide, cadmium selenides, and cadmium tellurides are among those described in these photovoltaic systems. (This updated bibliography contains 172 abstracts, 28 of which are new entries to the previous edition.)

44508 (SAND—78-7038(Vol.1)) **Photovoltaic transient analysis program user's guide. Volume I. Executive summary.** Lambarski, T.J.; Malmberg, A.F.; Melick, K.E.; Turfler, R.M.; Semmens, M.G. (BDM Corp., Albuquerque, NM (USA)). Oct 1978. Contract EY-76-C-04-0789. 29p. Dep. NTIS, PC A03/MF A01.

PV-TAP (Photovoltaic Transient Analysis Program) is a nonlinear, computer-aided circuit analysis program designed for the analysis of electrical and thermal transients in large photovoltaic array systems. It is an expanded version of the NET-2 code (a general network analysis code developed by BDM for the Federal government) including all the capabilities of Release 9.1 of NET-2 with additional models and mathematical functions appropriate to photovoltaic systems. The program has time and frequency domain, Monte Carlo, and optimization solution capabilities. PV-TAP is capable of a wide range of analyses. The code can be used to address design issues on the individual cell level or up to megawatt arrays. Some of the issues that can be addressed with PV-TAP include burnout analyses, illumination and load transients, fixed and propagating shadows, cell parameter optimization, collector and thermal system design trade-offs, power conditioning design analysis, aggregation pattern trade-offs, and many other types of analyses limited only by the user's imagination in applying this tool. This user's guide is presented in four volumes. This volume is an Executive Summary of the PV-TAP objectives and capabilities.

44509 (SAND—78-7038(Vol.2)) **Photovoltaic transient analysis program user's guide. Volume II. Guide to photovoltaic elements.** Lambarski, T.J.; Malmberg, A.F.; Melick, K.E.; Turfler, R.M.; Semmens, M.G. (BDM Corp., Albuquerque, NM (USA)). Oct 1978. Contract EY-76-C-04-0789. 262p. Dep. NTIS, PC A12/MF A01.

PV-TAP (Photovoltaic Transient Analysis Program) is a nonlinear, computer-aided circuit analysis program designed for the analysis of electrical and thermal transients in large photovoltaic array systems. It is an expanded version of the NET-2 code (a general network analysis code developed by BDM for the Federal Government) including all the capabilities of Release 9.1 of NET-2 with additional models and mathematical functions appropriate to photovoltaic systems. The program has time and frequency domain, Monte Carlo, and optimization solution capabilities. PV-TAP is capable of a wide range of analyses. The code can be used to address design issues on the individual cell level or up to megawatt arrays. Some of the issues that can be addressed with PV-TAP include burnout analyses, illumination and load transients, fixed and propagating shadows, cell parameter optimization, collector and thermal system design trade-offs, power conditioning design analysis, aggregation pattern trade-offs, and many other types of analyses limited only by the user's imagination in applying this tool. This volume is a guide to the use of the photovoltaic elements which have been integrated into NET-2 to form PV-TAP. For each element, the methodology of the model formulation, data reduction and input requirements, outputs available, and PV-TAP format statements and other user interface informationalong with examples are discussed. A separate chapter discusses the use of the photovoltaic system elements in combination with one another. An extensive bibliography is also included.

44510 (SAND—78-7038(Vol.3)) **Photovoltaic transient analysis program user's guide. Volume III. PV-TAP/NET-2 user's manual.** Lambarski, T.J.; Malmberg, A.F.; Melick, K.E.; Turfler, R.M.; Semmens, M.G. (BDM Corp., Albuquerque, NM (USA)). Oct 1978. Contract EY-76-C-04-0789. 297p. Dep. NTIS, PC A13/MF A01.

PV-TAP (Photovoltaic Transient Analysis Program) is a nonlinear, computer-aided circuit analysis program for the analysis of electrical and thermal transients in large photovoltaic array systems. It is an expanded version of the NET-2 code (a general network analysis code developed by BDM for the Federal Government) with additional models and mathematical functions appropriate to photovoltaic systems. The NET-2 manual augmented with photovoltaic elements is presented. This is volume III of a four volume report. (WHK)

44511 Performance of silicon and gallium arsenide concentration cells. O'Donnell, D.T.; Robb, S.P.; Rule, T.T.; Sanderson, R.W.; Backus, C.E. (Ariz State Univ, Tempe). pp 804-809 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Several organizations are currently developing cells that are especially designed for concentrated sunlight conditions. During the last year preliminary cells from five different organizations have been tested. Performance as a function of solar intensity as well as increasing temperatures have been measured. Many of the silicon cells have peak efficiencies in the 15-18% range. One Si cell tested maintained an efficiency of over 17% up to 400 suns. The peak efficiency of the GaAs cell tested was 21.7%.

44512 (UCID—18041-4) **Systematic computation of the performance of photovoltaic cells based on first principles. First and second quarter report, October 1, 1978—March 30, 1979.** Yee, J.H.; Burke, G.J.; Harvey, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 May 1979. Contract W-7405-ENG-48. 43p. Dep. NTIS, PC A03/MF A01.

The optical absorption coefficient for the ternary compounds $CdSiAs_2$ and $CuInSe_2$ have been calculated theoretically, based upon the pseudopotential technique and reflectivity data. The experimental absorption coefficient of $CuInSe_2$ agrees very well with the calculated absorption coefficient. Computer simulation was carried out for a CdS—$CuInSe_2$ heterojunction solar cell. The theoretical results compare favorably with the experimental result. Derivation of an expression for the minority-carrier diffusion length in $CuInSe_2$ together with some numerical results for the diffusion length are presented. The Schottky barrier height for Cu_2O has been calculated and the independence of the barrier height on the work function of the metals explained. A model explaining the unconventional behavior of indium doped CdS is presented. The model involves the formation of indium clusters causing conduction band distortions.

44513 (UCRL—81982) **AlSb as a potential photovoltaic material.** Armantrout, G.A.; Yee, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Apr 1979. Contract W-7405-ENG-48. 10p. (CONF-790457—6). Dep. NTIS, PC A02/MF A01.

From 1979 photovaltaic solar energy conference; West Berlin, F.R. Germany (23 Apr 1979).

AlSb is of interest as a terrestrial photovoltaic material due to the relative abundance and low cost of its constituents and also due to the high conversion efficiency demonstrated by the other III-V semiconductors, GaAs and InP. AlSb can be doped both n and p type thereby making homojunction formation possible. The performance at AM 1 of an AlSb homojunction device was studied theoretically using published and calculated values of the important cell parameters. It was found that eta $\leqq$ 13% for AlSb cells under realistic cell conditions and that such cells show a steady drop in efficiency for minority carrier lifetimes $< 10^{-8}$ seconds. Since AlSb departs thermodynamically from Stoichiometry due to Sb vacancy formation during growth, current Czochralski crystals will yield cells with eta $<$ 8% efficiency with values of eta $<$ 2% being more likely. Alternative growth techniques will be necessary to produce higher efficiency cells. Preliminary measurements of Schottky barrier cells made from Lawrence Livermore Laboratory Czochralski grown AlSb crystals have yielded cells with J/sub sc/ approx. = to 1.2 ma/cm^2 and V/sub oc/ = 66 mV. Barrier heights of 0.4-0.6 eV have been measured for ITO contacts. The low observed value of J/sub sc/ is likely due to the short bulk lifetime in the material being used.

44514 Plasma etching process for the manufacture of solar cells. Yerkes, J.W.; Avery, J.E. (to Atlantic Richfield Co.). US Patent 4,141,811. 27 Feb 1979. Filed date 24 Apr 1978. 6p.

A process for manufacturing solar cells is disclosed. Silicon wafers are assembled in a holding jig such as a diffusion boat in pairs with adjacent surfaces of each of the pairs in contact. The thus assembled wafers are subjected to a chemical vapor deposition diffusion step during which a phosphorous pentoxide glass layer is formed predominantly on the exposed surfaces and side edges of the wafers along with a PN junction thereunder. A small amount of the phosphorous pentoxide glass is also formed on the surfaces which are in contact with each other particularly at the outer edges thereof. The wafers are then reassembled in such a manner that the surfaces having the phosphorous pentoxide layer thereon are placed in contact with each other and again the wafers are placed in a holding jig. The thus assembled wafers are then placed in a plasma etching reactor for removal of the phosphorous pentoxide glass layer and the underlying PN junction from the side edges and the surfaces opposite the surfaces exposed during the previous diffusion step.

44515 Method of producing a PN junction type solar battery. Morimoto, K. (to Futaba Denshi Kogyo Kabushiki Kaisha). US Patent 4,140,610. 20 Feb 1979. Priority date 28 Jun 1976, Japan, 6p.

A PN junction type solar battery is disclosed comprising a plurality of alternate P-type and N-type semiconductor layers provided in a laminated manner parallel to an incident-light-receiving plane, connection ears provided opposite to each other and integrally connected to one end of each of the P-type and N-type semiconductor layers respectively, the connection ears being made of material of the same conduction type as the semiconductor layers respectively, and terminal electrodes mounted on the connection ears of the P-type and N-type semiconductor layers respectively so as to obtain ohmic contact therebetween. A method of producing a PN junction type solar battery in which P-type and N-type semiconductor layers are formed on a substrate in a staggered manner relative to each other preferably by the ion-beam deposition method or the cluster-ion-beam deposition method.

44516 Crystal growth and properties of CuGa/sub x/In/sub 1-x/Se$_2$ chalcopyrite compounds. Paorici, C. (CNR, Parma, Italy); Zanotti, L.; Romeo, N.; Sberveglieri, G.; Tarricone, L. *Sol. Energy Mater.*; 1: No. 1-2, 3-9(Feb 1979).

The preparation of single crystals of CuGa/sub x/In/sub 1-x/Se$_2$ by a chemical transport method in a closed tube is described. Electrical and optical properties, measured as a function of CuGa/

sub x/In/sub 1-x/Se_2 composition, indicate that this material, when coupled with zinc and cadmium chalcogenide windows, can be used as an absorber in heterojunction solar cells with near zero lattice mismatch.

44517 Effect of annealing on the optical properties of plasma deposited amorphous hydrogenated silicon. Tsai, C.C.; Fritzsche, H. (Univ. of Chicago, IL). *Sol. Energy Mater.;* 1: No. 1-2, 29-42(Feb 1979).

Amorphous silicon films prepared by radiofrequency plasma decomposition of silane contain between 10 and 25 at % hydrogen depending on the potential and temperature of the substrate and plasma parameters. The way hydrogen is bonded in these films has been determined from the infrared stretching, bending, and rocking or wagging modes of the Si—H complexes. Monohydrides SiH, dihydrides SiH_2 and short chains of polysilane (SiH_2)/sub n/ can be identified. The potential of the substrate with respect to the plasma and to a lesser degree the substrate temperature determine the prevalent Si—H complex. At substrate potentials close to that of the plasma (SiH_2)/sub n/ complexes are favored whereas isolated SiH and SiH_2 groups are found in films prepared on strongly negative potential substrates. The films can be dehydrogenated by annealing. Substrate potential and temperature influence strongly the refractive index and the onset of interband optical transitions. The optical gap of these films lies between 1.6 and 1.85 eV which is appreciably higher than the values 1.2 to 1.5 eV of sputtered and evaporated amorphous Si films. As the hydrogen is driven out by annealing the optical gap decreases to 1.6 to 1.7 eV. At photon energies below the optical gap one observes a preparation sensitive absorption tail between $\alpha = 10^2$ and 10^3 cm^{-1} which cannot be removed by annealing. The films crystallize between 700 and 780°C with a crystallization energy of (2 +- 0.3) kcal/mol. 40 references.

44518 Possibilities of new materials for solar photovoltaic cells. Schoijet, M. (Instituto Politecnico Nacional, Mexico City, Mexico). *Sol. Energy Mater.;* 1: No. 1-2, 43-57(Feb 1979).

The requirements for desirable technological properties of semiconductors for photovoltaic conversion are discussed and two criteria are suggested for the selection of materials that could guide the search towards low melting point compounds made of cheap component elements: (1) the use of a deviation from ideality vs energy gap diagram for the prediction of energy gaps from the knowledge of melting temperatures or vice versa; (2) the use of the Parthe—Goryunova—Mooser—Pearson criteria for compounds of which only their chemical formula is known but not their structure, in order to guess the structure and therefore be able to use the first criterion. For materials for Schottky devices a third criterion is necessary, derived by Nethercott that relates the Mulliken electronegativities of the component elements of a compound to its electron affinity. This can also be applied in the search of metallic alloys, semimetals or narrow band gap semiconductors that might replace the metal in a Schottky barrier. It is shown that a number of compounds exist which might meet these criteria. 136 references.

44519 Some relations governing major solar cell parameters. Ravindra, N.M.; Srivastava, V.K. (Univ. of Roorkee, India). *Sol. Energy Mater.;* 1: No. 1-2, 59-62(Feb 1979).

The theoretical results of Wysocki and Rappaport are expanded and some relationships between major solar cell parameters are derived and presented in the form of convenient working formulae using three parameters: temperature, bandgap, and efficiency.

44520 Cathodoluminescence characteristics of Cu/sub x/S films produced by different methods. Loferski, J.J. (Brown Univ., Providence, RI); Shewchun, J.; Mittleman, S.D.; DeMeo, E.A.; Arnott, R.; Hwang, H.L.; Beaulieu, R. *Sol. Energy Mater.;* 1: No. 1-2, 157-169(Feb 1979).

It is shown how the cathodoluminescence (CL) spectrum of chalcocite ($Cu_{2.00}S$) films like those in Cu—Cd—S solar cells can be used to develop information about the opto-electronic properties of the material. Comparison of the CL spectra of bulk polycrystalline samples known to be chalcocite with those of thin films produced by sulfurizing thin films of copper and of thin films produced by the chemical substitution processes commonly used to fabricate Cu—Cd—S cells, leads to the conclusion that the CL spectra of the latter may be affected by the presence of Cd as a dopant. This hypothesis was tested by observing the CL spectra of chalcocite samples which were doped with various amounts of cadmium. Comparison of these CL spectra suggests that chalcocite films derived from CdS contain 0.25 and 1.0 wt % Cd. The CL spectra of chalcocite films produced by dipping CdS crystals into aqueous solutions of cuprous chloride exhibit an ageing process whose cause has not been identified. Cathodoluminescence was also observed from thin film and sintered samples containing a tetragonal phase (not djurleite) having an approximate composition $Cu_{1.96}S$.

44521 Electric and photovoltaic properties of CdTe pn homojunctions. Mimila-Arroyo, J.; Marfaing, Y.; Cohen-Solal, G.; Triboulet, R. (CNRS, Meudon-Bellevue, France). *Sol. Energy Mater.;* 1: No. 1-2, 171-180(Feb 1979).

Shallow CdTe pn junctions were prepared by vapour phase epitaxy (CSVT method). Electric conduction is dominated by generation recombination in the space charge region. Low values of saturation current are measured (10^{-13}-10^{-10} A/cm^2) indicating a high quality junction interface. Recombination parameters are also determined: L/sub n/ = 0.51 μm, L/sub p/ = 0.28 μm and surface recombination velocity S = 10^6 cm/s. The conversion efficiency measured, 8%, corrected for reflexion losses, is mainly limited by surface recombination.

44522 Stability of SnO_2/n—Si solar cells. Fishman, C.; Ghosh, A.K.; Feng, T. (Exxon Research and Engineering Co., Linden, NJ). Contract EY-76-C-03-1283. *Sol. Energy Mater.;* 1: No. 1-2, 181-185(Feb 1979).

SnO_2/Si cells having ≧ 10% AMI engineering efficiencies were subjected to a variety of weathering conditions. Cells were encapsulated in Sylgard and then placed in a weatherometer and exposed to a deionized water spray and light from a carbon arc. Wire leads were soldered to the grids on the cells before encapsulation. Other cells were left unencapsulated and placed in a nitrogen dry box and exposed to light from an ELH lamp. The cells were kept at 48°C and the light I-V curves were four point measurements with no wire leads soldered to the grids. Several cells were placed in quartz jars in a N_2 atmosphere and then hermetically sealed. These cells were unencapsulated, had no wire leads, and the jars were placed in the weatherometer. Results indicated that the V initially decreased 3 to 5% of its initial value regardless of the cell's environment. The decrease then slowed and indicated a leveling behavior. The I/sub sc/ remained constant under all conditions. The fill factor for cells in the N_2 dry box decreased slightly (1 to 3%) and remained constant for cells in the quartz jars. Many of the cells with soldered wire leads indicated larger decreases in fill factor, associated with the cracking and pulling of the solder from the grids. The overall cell efficiency decreased ≈ 8% of the initial value for the encapsulated cells and decreased ≈ 3% or remained essentially unchanged for the cells in the N_2 dry box and the quartz jars, respectively. The instability of the SnO_2/Si device might prove to be a stabilizing of the SnO_2 stoichiometry or configuration and the SnO_2/silicon oxide interface. The surface states have been related to the V/sub oc/ and fill factor and might be altered after formation to cause the observed changes. Oxide growth might be a long term effect but there has been no indication of any I/sub sc/ decrease for the measured time period.

44523 Solar cell collector and method for producing same. Evans, J.C. Jr. US Patent 4,122,214. 24 Oct 1978. Filed date 21 Oct 1977. 5p.

A transparent, conductive collector layer containing conductive metal channels is formed as a layer on a photovoltaic substrate by coating a photovoltaic substract with a conductive mixed metal layer. A heat sink having portions protruding from one of its surfaces is attached. These protruding portions define a continuous pattern in combination with recessed regions among them such that they are in contact with the conductive layer of the photovoltaic substrate. Heating the substrate while simultaneously oxidizing the portions of the conductive layer exposed to a gaseous oxidizing substance forced into the recessed regions of the heat sink, creates a transparent metal oxide layer on the substrate. A continous pattern of highly conductive metal channels is contained in the metal oxide layer.

44524 Solar cells having integral collector grids. Evans, J.C. Jr. US Patent 4,104,084. 1 Aug 1978. Filed date 6 Jun 1977. 7p.

A heterojunction or Schottky barrier photovoltaic device is described, comprising a conductive base metal layer. A back surface field region was formed at the interface between the device and the base metal layer, a transparent, conductive mixed metal oxide layer in integral contact with the n-type layer of the heterojunction or Schottky barrier device. A metal alloy grid network was included. An insulating layer prevented electrical contact between the conductive metal base layer and the transparent, conductive metal oxide layer.

44525 Application of semiconductor diffusants to solar cells by screen printing. Evans, J.C. Jr; Brandhorst, H.W. Jr; Mazaris, G.A.; Scudder, L.R. US Patent 4,104,091. 1 Aug 1978. Filed date 20 May 1977. 5p.

Diffusants were applied onto semiconductor solar cell substrates, using screen printing techniques. The method was applicable to square and rectangular cells and can be used to apply dopants of opposite types to the front and back of the substrate. Then, simultaneous diffusion of both dopants can be performed with a single furnace pass.

44526 Photovoltaic cells. Jordan, J.F.; Lampkin, C.M. (to Photon Power, Inc.). US Patent 4,086,101. 25 Apr 1978. Filed date 14 Nov 1975. 12p.

A method is disclosed of making low cost photovoltaic cells on a large scale basis by means of a continuous process of coating sheet glass while the sheet glass moves in and has its under surface immersed in a tank of molten material, comprising forming the film of CdS microcrystals on the glass sheet, which has previously been coated with transparent SnO/sub x/ to a thickness of about 0.3 to 0.6 microns. A water solution of a cadmium salt, a sulphur compound, and an aluminum containing soluble compound is intermittenty sprayed on said glass while its exposed surface is maintained at a constant temperature in the range 500°F to 1100°F and while irradiating the surface with intense ultraviolet light so as to form a film of CdS microcrystals. This CdS film has Al impregnated within the stratum of the film adjacent to the SnO/sub x/, but only optionally has Al impregnated in the stratum of the CdS film adjacent to the exposed surface of the CdS film. After the spray process is completed, the temperature of the sheet of glass is brought to the range 450°C to 550°C, 525° being optimum. After heating, the glass is cooled to approximately room temperature and the exposed surface of the CdS is converted to Cu/sub x/S, the x of the Cu/sub x/S being as close to 2 as possible, by dipping the coated glass in a solution comprising: a solvent, which may be water; a weak acid, such as tartaric acid, citric acid, or lactice acid; a copper containing compound; and, optionally, a quantity of $H_3Ce(SO_4)_4$ and NaCl, or some other chloride; or by electroplating to form a film of Cu/sub x/S; or, by a combination of dipping and electroplating. The Cu/sub x/S forming process proceeds by ion exchange, i.e., S from CdS combines with Cu to form Cu/sub x/S. Cu is then applied over the Cu/sub x/S, and the cell is cured at a temperature in the range 400°F to 500°F.

44527 Increased photovoltaic conversion efficiency through use of spectrum splitting and multiple cells. Masden, G.W.; Backus, C.E. (Walla Walla Coll, College Place, Wash). pp 853-858 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Combined losses due to excess photon energy and energy from photons incapable of ionizing charge carriers accounts for over half of the energy entering a conventional solar cell. These losses can be markedly reduced by splitting the spectrum into parts and directing each part to a separate cell with characteristics designed to match the spectral distribution of the incident part. The total conversion efficiency for a two-cell system using a Ga(Al)As/GaAs cell and a Ge cell with a highly efficient filter-mirror can be 28% for AM2 spectral distribution with a concentration of 125. The projected conversion efficiency of a two-cell system using Si and a mateial having a band gap energy in the vicinity o1.75 eV is expected to be 31% or higher. An important feature of this beam-splitting method is a significant reduction in the internal energy losses in each cell over corresponding losses occurring in a single cell under the same illumination. Consequently, this method is particularly suited to operation with concentrated solar irradiation.

44528 Multigap solar cell requirements and the performance of AlGaAs and Si cells in concentrated sunlight. Moon, R.L.; James, L.W.; Vander Plas, H.A.; Yep, T.O.; Antypas, G.A.; Chai, Y. (Varian Assoc, Inc, Palo Alto, Calif). pp 859-867 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Multigap solar cells are capable of operating in concentrated sunlight with efficiencies >30%. If only two bandgaps are considered, their optimum values are 1.1 ev and 1.65 ev. Within this energy range Si and Al-Ga-column V alloys are possible materials and their relative merits are discussed. Experimentally, Al$sub x$Ga$sub 1-x$As for X<0.24 and Si have been tested individually and in combination with a spectral splitting filter. In combination of total efficiency of 28.5% including the filter has been observed at 165 AM 1.23 suns. For an ideal filter this corresponds to 31% combined cell efficiency.

44529 GaAs solar cells for high solar concentration applications. Ewan, J.; Knechtli, R.C.; Loo, R.; Kamath, G.S. (Hughes Res Lab, Malibu, Calif). pp 941-945 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Large-area GaAs solar cells capable of operating efficiently at high solar concentrations have been fabricated. The cells have an active area of 1 cm^2 and were designed specifically for operation at solar constants on the order of 1000 suns. They are fabricated using a modified infinite melt liquid phase epitaxy technique. The technique was used to grow the (AlGa)As layer and to form the active p-n junction. The depth of the p-n junction, which is an important cell parameter, should not be much less than 1 μm below the (AlGa)As-GaAs heterojunction. Cells with 1 cm^2 active area and fabricated with the technique have resulted in power outputs of greater than equivalent to20 W at 1000 SUNS. For an AM 1 spectrum, these cells have an efficiency of 20% at 1000:1 concentration ratios.

44530 Modified single diode model for high illumination solar cells for simulation work. Otterbein, R.T.; Evans, D.L.; Facinelli, W.A. (Ariz State Univ, Tempe). pp 1074-1079 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The purpose of this work was to investigate the applicability of simple solar cell models for use in simulating the behavior of current state-of-the-art silicon solar cells designed for use with optical concentration. Approximately 60 I-V curves from a Spectrolab concentrator cell, and Solarex 20X, 40X, and two 100X cells were examined. The data extended over a temperature range of 20°C to 70°C and a concentration range of 1 SUN (1000 W/m^2) to 100 SUNs. Attempts to reproduce these I-V curves through least squares fitting resulted in a single diode model with concentration dependent series resistances, concentration dependent diode imperfection factors, and concentration and temperature dependent reverse saturation currents. Series resistances were found to decrease rapidly as concentration increased and to level out to nearly constant values that were maintained from 20 to 100 SUNS. Diode imperfection factors took 20 to 100 SUNs. Diode imperfection factors took on values close to unity at one sun, and increased nearly linearly to values of 2.5 to 4 at 100 SUNS.

44531 Performance of a one kilowatt concentrator photovoltaic array utilizing active cooling. Burgress, E.L.; Pritchard, D.A. (Sandia Lab, Albuquerque, NM). pp 1121-1124 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Operational experience on a 1-kW concentrating photovoltaic array incorporating silicon solar cells and Fresnel lenses is reported. The arraY was operated in two modes of active cooling. The first mode provides cell cooling by pumping through tubes attached to the heat sink behind the solar cells. The array is also cooled in this mode by natural convection from both the front and back of the heat sink. The second mode of active cooling involves operating the array as a combined thermal/electrical system. In this combined thermal/electrical mode approximately 58% of the incident solar energy can be collected for thermal and electrical utilization.

44532 Ten kilowatt photovoltaic concentrating array. Donovan, R.L.; Hunter, H.C.; Smith, J.T.; Jones, R.L.; Broadbent, S. (Martin Marietta Corp, Denver, Colo). pp 1125-1130 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A Photovoltaic Concentrating Array (PCA) for terrestrial application is described. The PCA uses point focusing acrylic Fresnel lenses to concentrate sunlight on high intensity solar cells. The objective of the development is to obtain economical photovoltaic power generation by replacing relatively high priced solar cells with lower cost lenses. The PCA operates at a concentration of approximately 40, tracks the sun in two axes, and is passively cooled. Specific design problems and system tradeoffs addressed are lens and cell performance optimization, cooling, tracking, environmental considerations, and cell bonding and interconnection. Performance data on prototype modules are presented and design and manufacturing techniques emphasizing low cost materials and methods of assembly are discussed.

44533 10 kw photovoltaic concentrator system design. Castle, J.A.; Ronney, K. (Spectrolab, Inc, Sylmar, Calif). pp 1131-1138 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The detailed design of a 10 kw photovoltaic concentrator system has been completed in conjunction with the development of a 250 watt (nominal) concentrator unit, one integral module of the 10 kw system. The system consists of 40 of these modules. Each module uses two stage optical concentration. The optics consist of a linear parabolic trough and compound elliptical secondary mirrors. A geometrical concentration of 25 is used. The system tracks in two area. The modules are mounted on a carousel for azimuth tracking and are ganged in parallel for elevation tracking. The design utilizes passive cooling which provides nominal cell operating temperatures

in the range of 70 to 80°C. Extrapolating prototype unit test results, the 130 m² system output will be 11.3 kw with an ambient air temperature of 18°C and a wind of 6 m/sec.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 44464, 44467, 44468, 44469, 44546

44534 (FS—4-1977) **Harvesting and transport of forestry biomass for energy purposes.** Andersson, S.; Jonsson, Y.; Nylinder, M. (Forskningsstiftelsen Skogsarbeten, Stockholm (Sweden)). Sep 1977. 22p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

In the project whole-tree utilization (PHU) a survey of the possibilities of harvesting and transporting wood for energy purposes has been considered essential. The types of raw-material taken into consideration come from energy forests, logging residue, small trees from cleaning of both young stands and certain non-commercial areas. Many different methods for harvesting, transportation, and processing may be considered. At the best already developed techniques can be used but in most cases a completely new technique has to be worked out. General problems are low volume per tree and area, low solid wood content and scattered areas. According to a comparison between the costs for oil and domestic solid fuels the latter cannot compete with present oil prices. If, however, Swedish Forestry and Forest Industry would be interested in the above mentioned products and accept them as supplementary or alternative products to roundwood, conditions could rapidly change in case of further increased oil prices.

44535 (NP—23691) **Current awareness bulletin, January—February 1978.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). May 1978. 79p. Dep. NTIS (US Sales Only), PC A05/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

44536 (NP—23695) **Current awareness bulletin, August—September 1977.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). Nov 1977. 72p. Dep. NTIS (US Sales Only), PC A04/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

44537 (NP—23697) **Current awareness bulletin, June—July 1977.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). Sep 1977. 49p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

44538 (NP—23698) **Current awareness bulletin, April—May 1977.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). Jul 1977. 50p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

44539 (NP—23699) **Current awareness bulletin, January—March 1977.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). May 1977. 55p. Dep. NTIS (US Sales Only), PC A04/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 44625

44540 **Towards the design of contrived photosynthesizers.** Guruswamy, V.; Bockris, J.O'M. (Flinders Univ., Adelaide, Australia). *Sol. Energy Mater.;* **1**: No. 1-2, 141-156(Feb 1979).

Photosynthesis may be contrived to give H_2 and O_2. Biosystems are complex to work with; semiconductors in contact with electrolytic solutions offer more easily comprehended situations and may give enhanced efficiency of conversion of solar light (when compared with bio-conversion). What is needed are criteria for optimization (i) in respect to solid state factors connected with photoelectrochemical energy conversion; (ii) in respect to the competing side reactions which destroy the electrode materials; and (iii) with respect to the enhancement of conductivity which is often needed. Some quasi-quantitative numbers are derived. 33 references.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 44484, 44491, 44503, 44546

44541 (COO—4094-53) **Test plan for the Mead 25-kW Photovoltaic Flexible Test Facility "1979".** Hopkinson, R.F. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Mar 1979. Contract EY-76-C-02-4094. 21p. Dep. NTIS, PC A03/MF A01.

This test plan covers the operations of the Mead 25-kW Photovoltaic System and explains how the flexible test bed will be used in experiments with a variety of PV applications, including irrigation, crop drying and fertilizer manufacturing. MIT/Lincoln Laboratory developed this test plan in order to coordinate field experiments and to gain data on the characteristics of photovoltaic power systems. Lincoln Laboratory will manage and provide engineering services for new applications associated with this 25-kW photovoltaic power system. The planned operations for the Mead site during 1979 are given in detail, and a schedule is attached.

44542 (N—78-29116) **Space station systems analysis study, program review.** (Grumman Aerospace Corp., Bethpage, NY (USA)). 17 Jun 1976. Contract NAS8-31993. 123p. NTIS PC A06/MF A01.

Mission selection, operational solar power, and public service platform of the space station systems analysis study program are included.

44543 (N—78-29133) **Solar power satellite system definition study. part 3: preferred concept system definition.** (Boeing Aerospace Co., Seattle, WA (USA). Space Div.). May 1978. Contract NAS9-15196. 364p. NTIS PC A16/MF A01.

A concise but complete system description for the preferred concept of the Solar Power Satellite System is presented. Significant selection decisions included the following: (1) single crystal silicon solar cells; (2) glass encapsulated solar cell blankets; (3) concentration ratio 1; (4) graphite composite materials for primary structure; (5) electric propulsion for attitude control; (6) klystron RF amplifier tubes for the transmitter; (7) one kilometer diameter transmitter with a design transmission link output power of 5,000 megawatts; (8) construction in low earth orbit with self-powered transfer of satellite modules to geosynchronous orbit; and (9) two-stage winged fully reusable rocket vehicle for transportation to low earth orbit.

SOLAR THERMAL POWER PLANTS

44544 (CONF-7805148—(Absts.)) **Abstracts of presentation DOE/DST Advanced Thermal Power Program review.** (Department of Energy, Washington, DC (USA); Jet Propulsion Lab., Pasadena, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). 1978. Contract EG-77-C-01-4042. 227p. Dep. NTIS, PC A11/MF A01.

From DOE/DST advanced thermal power program review; Golden, CO, USA (9 May 1978).

Abstracts of 33 papers are presented. Topics include new concept demonstrations (receivers, concentrators, engines, heat transport, and storage); advanced system and subsystem development; materials and coatings supporting technology (coatings, reflective surfaces, and environment); and technology assessment and direction (new uses and test facilities). (WHK)

44545 (NTISUB/C—450) **Solar thermal power generation, 1977; solar heating and cooling, 1977; solar thermal components, 1977. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1977. 12p. University of New Mexico, Albuquerque.

This bibliography with abstracts consists of quarterly reports in the areas of solar thermal power generation, solar heating and cooling, and solar thermal components.

44546 (NTISUB/C—451) **Solar thermal power generation, 1977. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1977. 4p. Paper copy available on subscription, North American Continent price $75.00/year; all others write for quote.

This bibliographic series cites and abstracts literature and technical papers on electrical power generation primarily through solar thermal processes. The reports are divided into ten categories: Energy Overviews, Solar Overviews, Economics and Law, Thermal Power, Thermionics, Ocean Thermal Differential, Wind Conversion,

Biomass, Residential Systems, and Large Scale Photovoltaic and Hydrogen Production.

44547 (SAND—78-2163C) **Sandia Laboratories operational experience with small heat engines in solar thermal power systems.** Abbin, J.P. Jr. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790803—23). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Portions of document are illegible.

During the time that Sandia Laboratories has been engaged in solar energy research and development, a significant amount of hardware and operating experience has been obtained from the construction and testing of two small Rankine-cycle solar thermal power plants. The first plant is part of a prototype solar total energy system with an electrical generating capacity of 32 kW, and the second plant is part of a prototype solar irrigation unit with a shaft power output of 19 kW or an electrical output of 15 kW. The energy-conversion hardware is described, and the performance and operating experience with the units, are summarized.

44548 (DOE-tr—159) **Photothermal conversion of solar energy into electricity.** Moragues, J.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1978. Translation of Argentine report. 37p. Dep. NTIS, PC A03/MF A01.

Brief descriptions of various collectors that can be used for electricity production by solar photothermal conversion are given including solar stills, shallow solar ponds, flat plate collectors, fixed collectors with moderate concentration, cylindrical-parabolic concentrators, fixed concentrators, fixed concentrators with faceted mirror, concentrations with concave rotating multiple mirrors, Fresnel lenses, paraboloidal rotating concentrators, semispherical fixed concentrators, central receiver system with linear focus, and central receiver system with point focus. Other topics include thermodynamic cycles, energy transport, energy storage, and economics. A review of some of the programs throughout the world in development of solar thermal power conversion is included. (WHK)

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 44414

44549 (ATR—78(7747)-1(Vol.1)) **10 MW solar thermal pilot plant dynamic simulation. Volume I. Computer program description.** (Aerospace Corp., El Segundo, CA (USA)). 1 Dec 1978. Contract ET-78-C-03-2028. 154p. Dep. NTIS, PC A08/MF A01.

The Department of Energy (DOE) is currently in the initial phase of a development project to produce a prototype Solar 10 MW (electric) Pilot Power Plant near Barstow, California. As part of this early development. The Aerospace Corporation has developed a digital computer simulation of this pilot power plant. The simulation program is presented. The simulation program has been designated STMPPS (Solar Ten Megawatt Pilot Plant Simulation). This simulation is operative on The Aerospace Corporation Control Data Corporation (CDC) 7600 digital computer, with use of the CDC SCOPE 2.1 operating system.

44550 (ATR—78(7747)-1(Vol.2)) **10 MW solar thermal pilot plant dynamic simulation. Volume II. Computer program source listing.** (Aerospace Corp., El Segundo, CA (USA)). 1 Dec 1978. Contract ET-78-C-03-2028. 271p. Dep. NTIS, PC A12/MF A01.

The actual computer source listing of Program STMPPS is presented. Included in the listing are all routines specifically developed by The Aerospace Corporation in meeting the requirements of this task. Logic and analytical details on which the program is based are described in detail in Volume I. The listing contains a generous amount of nonprogrammatic comment lines to aid in interpretation of program logic. It is intended that Volumes I and II taken together allow Users to fully understand and utilize Program STMPPS capabilities.

44551 (COO—4878-3) **Novel ceramic receiver for solar Brayton systems.** Jarvinen, P.O. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract ET-78-S-02-4878. 7p. (CONF-790305—7). Dep. NTIS, PC A02/MF A01.

From ASME gas turbine closed-cycle session; San Diego, CA, USA (11 Mar 1979).

Substantial progress is reported in the development of a high-temperature seal for a solar heated-air cavity receiver. Mechanical dome sealing methods are selected as the preferred sealing approach and a free-standing hemisphercal dome contact-type seal and a clamped shallow dome seal are chosen for preliminary design, analysis, and fabrication. Analytical and experimental investigations establish the technological foundation of the seal concepts by demonstrating that ceramic domes can be designed to support the combined pressure, thermal stress, and temperature loads of a heated-air receiver, that a mechanical contact seal with a leak rate which is two orders less than the design goal leak rate is feasible, and that metalization of ceramics and the formation of an alternative brazed diaphragm seal are possible.

44552 (SAN—1605-7(Vol.1)) **Solar central receiver prototype heliostat CDRL item B.d. Final technical report, volume 1.** Easton, C.R. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Aug 1978. Contract EG-77-C-03-1605. 339p. (MDC-G—7399(Vol.1)). Dep. NTIS, PC A15/MF A01.

The preliminary design of a heliostat for central receiver solar thermal power systems which projects to meet the DOE's goal of $\$72/m^2R$ at production volumes as low as 25,000 units per year and reduces to less than $\$60/m^2R$ in very high volume production (~ 1,000,000 units per year) is presented. The manufacturing process, installation and checkout procedures, operation and maintenance procedures, and specification verification and optimization are described. (WHK)

44553 (SAND—79-8183) **Interim structural design standard for solar energy applications. Final report, Phases 1 and 2.** Berman, I.; Gangadharan, A.C.; Gupta, G.D.; Narayanan, T.V. (Foster Wheeler Corp., Livingston, NJ (USA)). Jan 1979. Contract AC04-76DP00789. 148p. Dep. NTIS, PC A07/MF A01.

The program is summarized. Central Receiver Solar Thermal Power Systems, relevant ASME Codes, reliability considerations, and the criteria used to develop the Interim Design Standard is reviewed. The Interim Design Standard is presented. All criteria or rules chosen or adapted from other codes are fully stated including all design data. A detailed paragraph-by-paragraph explanation of the Interim Design Standard is provided. The test and development program needed to generate new design data and to update the Interim Design Standard are identified. (MHR)

44554 (SAND—79-8225) **Weathering of low iron float and CGW-0317 glasses.** Shelby, J.E.; Vitko, J. (Sandia Labs., Livermore, CA (USA)). May 1979. Contract EY-76-C-04-0789. 23p. Dep. NTIS, PC A02/MF A01.

A simple accelerated weathering test was used to evaluate the relative weatherability of glasses which are being considered for use in solar heliostats. Glasses were exposed to 98 to 100% humidity at temperatures ranging from 40 to 80°C for periods of one to four weeks. Under these conditions, low-iron float glass exhibits severe surface corrosion, which occurs predominantly on the tin poor surface. This result indicates that silvering the tin-poor surface will increase the weatherability of mirrors made from this glass. CGW-0317 fusion glass exhibits no detectable signs of surface corrosion.

44555 (TID—29443) **Materials testing for central receiver solar-thermal power systems.** Majumdar, S. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

The program consists of three subtasks: (1) biaxial creep-fatigue tests (constant tensile hoop stress and cyclic axial strain with hold times in compression) will be performed on Type 316H stainless steel superheater tubing; (2) a comprehensive survey of information on sodium effects on candidate materials for solar-thermal electric piping and steam generators is being conducted; and (3) mechanical-properties data generation in support of the ASME code development. The status of the program is briefly described. (WHK)

44556 (SAND—78-2041(Vol.4)(No.3), pp 8-11) **Deep-well solar irrigation experiment.** Alvis, R.L. Nov 1978.

In Sandia technology.

The location and detailed layout of the solar irrigation project on the Dalton Cole farm near Coolidge, Arizona are shown. The design for this deep-well irrigation experiment uses a distributed field of trough-type solar collectors and an organic Rankine cycle heat engine. (MHR)

DISTRIBUTED COLLECTOR

44557 (BMFT-FB-T—78-33) **Development of a prototype of a 10 kW/sub el/-solar power station.** Wolf, D.; Bihlmayr, H.; Carl, J.; Merges, V.; Prikryl, P.; Vinz, P. (Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.)). Sep 1977. 167p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

In the Federal Republic of Germany the described plant was commissioned as the first fully integrated solar power plant. Beyond this in the Federal Republic of Germany three other small plants for the generation of electricity from solar energy are being developed. The aim had been the development of a small solar power plant for generation of electricity in a autonomous operation using technologies as simple as possible and components from series production. The development of the small solar power plant advanced in the two planned phases: (1) design, installation and commissioning of the plant and of the supporting systems; (2) performance of a test program. During acceptance tests for the customer the specified maximum net power output of 10 kW/sub el/ at a cooling water

temperature of 35°C, the observance of the voltage- and frequency tolerances of the generated current, and the partial load operation were successfully demonstrated. Further tests under real operation conditions in long term operation mode will be performed n Madras, India.

44558 (N—79-11474) **Program Thek energy production units of average power and using thermal conversion of solar radiation.** (National Aeronautics and Space Administration, Washington, DC (USA)). Nov 1978. Translated from Programme Thek, Unites de Production d'Energie de Moyenne Puissance Par Conversion Thermique du Rayonnement Solaire, Sep. 1977, 6p. 16p. NTIS PC A02/MF A01.

General studies undertaken by the C.N.R.S. in the field of solar power plants have generated the problem of building energy production units in the medium range of electrical power, in the order of 100 kW. Among the possible solutions, the principle of the use of distributed heliothermal converters has been selected as being, with the current status of things, the most advantageous solution. This principle consists of obtaining the conversion of concentrated radiation into heat by using a series of heliothermal conversion modules scattered over the ground; the produced heat is collected by a heat-carrying fluid circulating inside a thermal loop leading to a device for both regulation and storage.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 44547

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 44546, 44708

44559 (CONF-790444—2) **OTEC power systems.** Horowitz, J.S. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From Offshore technology conference; Houston, TX, USA (30 Apr 1979).

The development of power systems is a key part of the Ocean Thermal Energy Conversion (OTEC) program. The power system development centers on two sets of contracts designated as: PSD-I and PSD-II. These contracts are directed towards: the design of an OTEC power module, the fabrication of a test article for an ocean going test on OTEC-I, and the fabrication of a 10MWe (net) power system. The PSD-II program was planned to explore the possibility of lower cost power systems through the use of shell-less (or non-shell-and-tube) heat exchangers. An up to date description of the technical features of each of these design studies is presented. Included will be: heat exchanger design, biofouling control, rotating equipment, auxiliaries, plant layout, and system cost. The role of the power systems development program in the larger OTEC program is also discussed.

44560 (CONF-790631—1) **Experimental and analytical OTEC studies at ORNL.** Michel, J.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

The results of ammonia heat transfer experiments and various analytical studies of OTEC heat exchangers are summarized. Work done since that reported at the Fifth OTEC Conference includes additional ammonia condensation tests on several vertical fluted tubes and on tubes inclined at 30° from the vertical position. The main conclusions from these tests are that the high condensation coefficients previously reported for fluted tubes have been verified and they seem to be insensitive to tube length over the range tested. Also, tilting the tubes significantly improves the performance of smooth tubes and causes a slight decrease in the performance of fluted tubes. Testing of vertical tubes for ammonia evaporation is currently in progress with evaluation of both in-tube and outside tube evaporation experiments planned. Analytical studies include evaluating the cost effectiveness of various types of heat transfer enhancement and performing a survey of heat exchanger joinability. Also, several studies are in progress relative to alternate OTEC cycles and components for these cycles.

44561 (CONF-790631—2) **OTEC system response and control analysis.** Owens, W.L. (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). 1979. Contract ET-78-C-01-3407. 7p. Dep. NTIS, PC A02/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

An analysis is presented for OTEC system response and control. Two basic operational modes are considered consisting of constant and variable flow seawater pumps. Variable flow seawater pumps allow optimization of the OTEC thermal cycle state points for maximization of net generated power. Constant flow pumps are cheaper and simpler, but do not permit direct control over the evaporator and condenser operating temperatures. A system of nonlinear differential equations representing the basic elements of a constant seawater flow OTEC plant has been formulated for computer solution. Typical response curves are presented for pressures, temperatures, mass flow rates, and generator speed for the Mini-OTEC plant scheduled for operation later this year.

44562 (HCP/T2898—01/3) **OTEC thermal resource report for Pacific plant ship, 5 to 10°N 90 to 95°W.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 44p. Dep. NTIS, PC A03/MF A01.

The temperature difference resource for the plant ship region between 5 to 10° North latitude and 90 to 95° West longitude is an excellent one for potential OTEC use. Surface temperatures are consistently high with the monthly mean temperatures ranging from 26.5°C to 28.5°C. An annual mean ΔT greater than 20°C is available at 550 meters. Bottom depths are much greater than 1500 meters for the entire plant ship region. The mixed layer depth is very shallow throughout the year, and may be nonexistent at times indicating a warm water intake near the surface. High winds and storms are not a major problem for this site, due in part to the proximity to the equator. Mean surface currents are somewhat larger in magnitude than other Pacific sites. The site chosen is located near the approximate limits of the North Equatorial Current and the Pacific Equatorial Countercurrent. Current shear may cause problems.

44563 (NTIS/PS—78/1223) **Solar sea power plants (citations from the NTIS data base). Report for 1964-October 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 215p. NTIS PC N01/MF N01.

Federally-funded research studies dealing with the technical and economic feasibility of solar sea power plants are discussed. Topic areas cover condenser, evaporator, and heat exchanger design; and, fouling and corrosion prevention. Included are a few abstracts pertaining to site selection, dynamic modeling studies, and general studies dealing with solar sea power as an energy alternative. (This updated bibliography contains 210 abstracts, 59 of which are new entries to the previous edition.)

44564 (NTIS/PS—78/1224) **Solar sea power plants (citations from the Engineering Index Data Base). Report for 1970-October 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 128p. NTIS PC N01/MF N01.

The present status and future prospects of using the ocean thermal gradient for production of electric power are discussed in these citations from worldwide research. Engineering, economic, and feasibility studies are covered, including studies dealing with systems and component design. (This updated bibliography contains 124 abstracts, 25 of which are new entries to the previous edition.)

44565 (PNL—2739(Pt.1)) **Ocean Thermal Energy Conversion (OTEC) Biofouling and Corrosion Experiment (1977), St. Croix, U.S. Virgin Islands. Project summary, final report. Part I of a three-part report.** (Tracor Marine, Port Everglades, FL (USA). Ocean Technology Div.). Feb 1978. Contract W-31-109-ENG-38;EY-76-C-06-1830. 51p. Dep. NTIS, PC A04/MF A01.

A limited, eleven-week OTEC test program of heat transfer, biofouling, and corrosion measurements was successfully conducted in the open ocean 13 kilometers north of St. Croix, U.S. Virgin Islands, during the summer of 1977, aboard a unique U.S. Navy deep-moored surface laboratory. Seawater for these experiments was drawn from a depth of 20 meters. Heat transfer measurement equipment, materials, and procedures duplicated earlier near-shore Hawaiian tests as closely as possible, to produce comparable data for the Eastern Caribbean. A separate (auxiliary) rack of tubes simulating conditions in the heat transfer systems was constructed and independently supplied with seawater. This permitted measurements and sampling of the mock heat exchanger tubes throughout the term of the experiment without disturbance of the heat transfer systems. 6061-T6 aluminum pipes were used in both the heat transfer devices and the auxiliary rack to permit direct comparison with the Hawaiian work. Several tubes of 5052 aluminum were also tested in the auxiliary rack. Measurements of a number of intake water characteristics were conducted throughout the test period and proved to be relatively constant. Inorganic nutrients, ATP, bacteria, fungi, POC and PON levels were low, and similar to other values measured in semi-tropical waters. This first attempt to characterize chemical and biological components of the fouling layer, and to correlate these observations with measurements of heat transfer and intake water characteristics has produced valuable engineering data, and has provided the groundwork for future research along these lines.

44566 (PNL—2739(Pt.2)) **Ocean Thermal Energy Conversion (OTEC) Biofouling and Corrosion Experiment (1977), St. Croix, U.S. Virgin Islands. Corrosion studies, final report. Part II of a three-part**

report. Munier, R.S.C.; Craig, H.L. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). Feb 1978. Contract W-31-109-ENG-38;EY-76-C-06-1830. 85p. Dep. NTIS, PC A05/MF A01.

An experiment was performed at an offshore site north of St. Croix, U.S. Virgin Islands, to determine the microbial fouling and corrosion behavior within simulated aluminum OTEC heat exchanger tubes under flowing seawater conditions and to relate this timed sequence of observations to the degradation of heat transfer measured in an independent, but parallel experiment. In addition, baseline oceanographic data was collected in order to better understand the mechanisms of biofouling and corrosion development by characterizing physically, chemically, and biologically the seawater environment in which the experiment was run. Presented is the corrosion task only. The experimental procedure is described and the results are presented and discussed.

44567 (TID—29418) **OTEC platform configuration and integration. Volume I: systems engineering and integration. Final report.** (Rosenblatt (M.) and Son, Inc., New York (USA)). 7 Jul 1978. Contract EG-77-C-01-4065. 228p. Dep. NTIS, PC A11/MF A01.

The commercialization of OTEC platforms requires the following basic decisions to be reached prior to initiation of any final design and construction efforts: (1) selection of the best platform hull shape; (2) selection of the best cold water pipe configuration; (3) selection of the best positioning system; and (4) development of a conceptual design for platform ocean systems. The current Department of Energy study for "OTEC Platform Configuration and Integration" strived to arrive at these decisions in two phases. The first phase consisted of evaluation investigations to obtain the ranking of candidate ocean systems, and the second phase involved the performance of a conceptual design for two selected platform candidates. In this first volume of a three volume report, the results of phase-one investigations are presented. An evaluation methodology was developed for the purpose of analyzing the ocean system requirements against the site criteria and in arriving at the conclusions as far as hull, seawater system, positioning system, and other ocean systems characteristics. Feasibility studies and cold water pipe/hull stress analyses indicated that the best platform hull shape would be one that would have a submerged main body and the cold water pipe would be attached to it in a flexible joint type configuration, possibly with flexible joints along the length as well. The best positioning system would be a static mooring system, possibly 3-leg, using hollow cylindrical links for lines.

44568 **Ocean thermal plant.** Owens, L.J. US Patent 4,087,975. 9 May 1978. Filed date 29 Mar 1977. 10p.

A floating energy converter is described which uses large volumes of sea water to produce electrical power. In this plant, a fluid working medium is pumped to an evaporator where is is heated by a flow of warm surface sea water. The fluid in liquid form boils to a pressurized gas vapor which is routed to drive a turbine that, in turn, drives a generator for producing electricity. The gas vapor then enters a condenser immersed in cold sea water pumped from lower depths, condenses to its original liquid form, and then pumped to the evaporator to repeat the cycle. Modular components can be readily interchanged on the ocean thermal unit and inlet pipes for the sea water are provided with means for maintaining the pipes in alignment with the oncoming current. The modular construction allows for the testing of various components to provide a more rapid optimization of a standardized plant.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 44545, 44962

44569 (NTISUB/C—453) **Solar thermal components, 1977. Quarterly repts.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1977. 4p. Paper copy available on subscription, North American Continent price $75.00/year; all others write for quote.

This bibliographic series cites and abstracts literature and technical papers on components applied to solar thermal energy utilization. The quarterly volumes are divided into ten categories: Material Properties, Flat Plate Collectors, Concentrating Collectors, Thermal Storage, Heat Pumps, Coolers and Heat Exchangess, Solar Ponds and Distillation, Greenhouses, Process Heat, and Irrigation Pumps. Author and permuted keyword/subject term indexes are included for easy reader access.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 44626, 44630, 44631

44570 (BNL—25908) **Design, construction, and operation of the solar assisted heat pump ground coupled storage experiments at Brookhaven National Laboratory.** Metz, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790446—3). Dep. NTIS, PC A02/MF A01.

From 4. annual heat pump technology conference; Stillwater, OK, USA (9 Apr 1979).

An experimental program to study the use of thermal coupling between the earth and the storage element of a series solar assisted heat pump system is underway at Brookhaven National Laboratory. The design, construction, and initial operation of the eight, first generation, experiments that were built during 1978 are discussed. Four of these experiments involve buried tanks, and four used buried serpentine coils of 1 1/2 inch diameter flexible polyethylene pipe in various configurations and lengths. Heat is added to or removed from each experiment by hot water heaters or heat pumps. The amount of heat added or removed is determined by a computer program which simulates all parts of the solar system (collectors, heat pump, climate and load) except for the ground coupling device. Each experiment is run according to a different scenario or control strategy. In addition to the eight major experiments discussed other experiments have been conducted to determine ground thermal conductivity, heat capacity, diffusivity, and moisture content. The overall research program plan and some early results are also discussed.

44571 (COO—2858-23) **Solar cooling performance in CSU Solar House III.** Ward, D.S.; Ward, J.C.; Oberoi, H.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Jan 1979. Contract EY-76-S-02-2858. 20p. Dep. NTIS, PC A02/MF A01.

Preliminary performance and pertinent operating experience with a liquid-heating flat-plate solar collector integrated with a residential solar heating and cooling system is presented. Data for the months of July and August (1978) are included, along with an analysis of the operation of the solar cooling system which utilizes the Yazaki 2-ton lithium bromide absorption chiller and a cool storage subsystem. Results of the analysis provide clear indications of the critical importance of temperature differentials between the collector outlet and the absorption chiller generator inlet, the effects of alternative control strategies, the marginal feasibility of cool storage, the devastating effect on system performance of the heat losses from the thermal storage unit, and the importance of parasitic power requirements on the ultimate feasibility of solar absorption cooling.

44572 (LBL—8777) **Routine spectral measurements of infrared radiation from the atmosphere.** Berdahl, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 8p. (CONF-790355—1). Dep. NTIS, PC A02/MF A01.

From 2. international conference on infrared physics; Zurich, Switzerland (5 Mar 1979).

A quantitative knowledge of the infrared radiative transfer between the atmosphere and a building's surface requires detailed information regarding the angular and spectral distribution of the radiation from the atmosphere. Routine information of this type has apparently never been gathered; most observations are limited to several days in time. The filter spectrometer system described here is intended to provided data records at 30 minute intervals for weeks and months of continuous operation. The spectrometer design incorporates a Barnes Corporation model 12-880 radiometer equipped with an eight-position filter wheel, germanium lens, and pyroelectric detector.

44573 (NMEI—23-SA) **Theoretical analysis of a passive heat pipe heating and cooling system. Semiannual report, July 1, 1978—December 31, 1978.** Feldman, K.T. (New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). May 1979. 46p. New Mexico State Univ., Las Cruces.

A totally new concept which combines both a heat pipe and a flat plate solar collector for daytime solar water heating and nighttime water cooling has been studied theoretically. Since the heat pipe is a passive heat transfer device, the entire system requires no pumps or auxiliary power for its operation. This makes the system reliable and should require very little maintenance. This system with a collector area of 400 ft^2 can meet both winter space heating and summer space cooling requirements. For a typical winter day it can provide about 8000 lbs/day of hot water at 140°F or about 530,000 Btu/day. For a summer day it can provide about 4000 lbs/day of chilled water at 45°F or about 100,000 Btu/day for space cooling.

44574 (NTISUB/C—452) **Solar thermal heating and cooling, 1977. Quarterly repts.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1977. 4p. University of New Mexico, Albuquerque.

This bibliographic series cites and abstracts the literature and technical papers on the heating and cooling of buildings with solar thermal energy. The quarterly volumes are divided into ten catego-

ries: Space Heating and Cooling Systems, Space Heating and Cooling Models, Building Energy Conservation, Architectural Considerations, Thermal Load Computations, Thermal Load Measurements, Domestic Hot Water, Solar and Atmospheric Radiation, Swimming Pools, and Economics. Author and permuted keyword/subject term indexes are included for easy reader access.

44575 (SAN—1439-8) **Analysis of advanced conceptual designs for single-family-size absorption chillers. Project 9101 semi-annual technical status report, September 1, 1977—March 31, 1978.** Macriss, R.A.; Zawacki, T.S.; Kouo, M.T.; Cole, J.T. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1978. Contract EG-77-C-03-1439. 33p. Dep. NTIS, PC A03/MF A01.

The results of a preliminary exploratory research study to identify new and potentially improved fluid systems for solar-powered absorption cooling are presented. The study included a thorough state-of-the-art review, preliminary screening of over 100 potential refrigerants and over 100 potential absorbents. Among these, six groups of refrigerants were selected for further consideration resulting in about 100 potential refrigerant—absorbent combinations. Based on criteria established for the selection of candidate systems, and with the help of two laboratory screening tests, 54 refrigerant—absorbent systems were identified as potentially useful and another 27 new systems were synthesized by combination of appropriate refrigerants and absorbents.

44576 (SAN—1514-1) **Solar heating system at the Albuquerque Animal Control Center. Final technical report.** (Bickle (Larry W.) and Associates, Albuquerque, NM (USA)). 16 Feb 1979. Contract EG-77-G-03-1514. 145p. Dep. NTIS, PC A07/MF A01.

The solar heated addition to the Albuquerque Animal Control Center provides that facility with an additional 2,200 square feet of office space and 4,300 square feet of kennel and non-office area. The active system consists of 650 square feet of concentrating, tracking solar collectors, and an atmospheric pressure water storage tank of 1,500 gallons. The passive solar heating system consists of a clerestory window that is approximately 28% of the heated floor area of the kennels. A hinged combination reflector and night insulation panel is used to direct the solar energy onto the floor in the kennels. Included here are: a general description of th system, as-built piping and wiring diagrams, major maintenance and construction problems encountered, updated system performance data, acceptance test plan and results, operation and maintenance manual and a brochure for public dissemination. (MHR)

44577 (SAN—1590-1/1) **Development of a high temperature solar powered water chiller. Volume I. Phase I technical progress report, September 26, 1977—June 1, 1978.** English, R.A. (Carrier Corp., Syracuse, NY (USA). Energy Systems Div.). Jun 1978. Contract EG-77-C-03-1590. 92p. Dep. NTIS, PC A05/MF A01.

Phase I work presents a conceptual design of a high temperature solar powered water chiller. State-of-the-art work in the field of organic Rankine cycles is reviewed. Various Rankine cycle driven vapor compression configurations are evaluated, as well as the effect of design parameters and working fluid selection. R-113 is the recommended fluid for both cycles. A conceptual design of a hermetic high speed turbine driven centrifugal compressor is presented. Several alternate variable speed electric motor drives are described, with the high frequency induction motor which is mounted on the shaft between the turbine and compressor favored. Various aerodynamic impeller designs are evaluated to optimize the single stage R-113 compressor impeller. The performance of the chiller system over a wide range of expected operating conditions is predicted. Control strategies for the turbo/compressor/motor unit are described. System simulation of the proposed chiller for a commercial building application in two cities is described, with preliminary results. A preliminary appraisal of owner's costs is given, as well as an assessment of the environmental impact of the chiller.

44578 (SERI/TP—49-063) **Preconference proceedings: solar heating and cooling systems operational results.** (Department of Energy, Washington, DC (USA)). 1978. 368p. (CONF-781102—). Dep. NTIS, PC A16/MF A01.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Separate abstracts were prepared for 45 of the 50 papers presented. The remaining five papers were previously abstracted and included in the data base. (WHK)

44579 (SERI/TP—49-063, pp 1-5) **Performance of HUD residential solar systems.** Freeborne, W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Department of Housing and Urban Development (HUD) has participated in the instrumentation of a portion of the projects receiving grants in the solar demonstration program. Knowledge gained from instrumenting approximately 30 projects with data starting to be recorded in the fall of 1977 is reported. The instrumented data will be supplemented with results from interviews with grantees (usually the project builder) and the purchaser of the solar units. Active solar heating systems have had problems with collector, storage, distribution, and control which are gradually being corrected. These heating systems are delivering 5 to 8% of the solar incident, but these percentages will improve as storage leakage and distribution inefficiencies are corrected. Solar must be delivered to the units in a more direct manner. Passive solar heating systems are delivering at a much higher rate of efficiency than the active heating systems (43%), but methods to control storage temperatures must be implemented. Domestic hot water systems are delivering 20% of the solar incident upon the collector arrays, but storage and other standby losses must be reduced to lower the amount of input required.

44580 (SERI/TP—49-063, pp 7-10) **Utilization of operational results.** Ward, D.S. (Colorado State Univ., Fort Collins). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

To be of any value the operational results of solar space heating and cooling systems must be viewed as a means of improving the technical and economic advantages of this class of solar energy system. Individual installations should not be viewed as successes or failures, but to the degree that practitioners can learn from them, and ultimately improve their designs, methods, and practices. Specific attention must be directed toward the concept of daily efficiencies of solar collectors and overall system efficiency before practical conclusions can be reached. In addition, the effects of piping and/or ducting and thermal storage heat losses, installation procedures, choice of control strategies, solar operating thresholds, parasitic power requirements, etc., must also be considered in order to adequately judge the performance of a solar system.

44581 (SERI/TP—49-063, pp 21-29) **Thermal performance evaluation of the Alpha Construction Company solar energy system.** McCumber, W.H. Jr. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Alpha Construction Company solar energy system in Canton, Ohio, and its modes of operation are described. A performance evaluation of the system based on instrumented data collected between March and August, 1978, is presented. The evaluation is based on operational conditions measured at the site. This solar energy installation provides space heating and hot water pre-heating for a single family residence. Uncontrolled energy leaking into the conditioned space increased summer cooling system loads. These leaks are from ducts, from storage and from imperfectly sealed dampers. Savings during the heating season were more than offset by losses in the cooling season.

44582 (SERI/TP—49-063, pp 41-47) **Thermal performance evaluation of the Florida Gas Company solar energy system.** Lee, T.D. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

A performance evaluation of the Florida Gas Company solar energy system in Winter Springs, Florida, is presented for the period from May through August, 1978. The system is described briefly including the principal modes of solar operation. The solar energy system provided 41 percent of the space cooling load. There was no space heating or domestic hot water demand. Energy savings resulting from the use of solar energy are presented, and suggested system design improvements are recommended.

44583 (SERI/TP—49-063, pp 49-53) **Solar air-heating and heat pump cooling in CSU solar house II (1977—78).** Karaki, S. (Colorado State Univ., Fort Collins). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The principal objectives of the project are to determine and evaluate the seasonal performance of a solar air-heating system for space and water heating with a standard heat pump for cooling. Later in the 1978—79 heating season, the performance of a heat pump as an auxiliary heating unit to the solar heating system will be evaluated. The results presented are only for the solar air-heating system for the period from 16 June 1977 through 14 May 1978 because the results of space cooling with a heat pump during the summer of 1978 were not analyzed at the time this paper was prepared. Data for cooling will however be presented at the Conference, and supplementary material will be made available. An air-heating solar system is very effective in providing space heating. With 67.1 m^2 of collectors, 80 percent of the heating needs, or a seasonal average of 295.3 MJ/day was supplied by the solar system

from 8 October 1977 through 14 May 1978. In addition, the system provided 72 percent of the heat used for domestic water heating, with an average hot water use of 300 liters/day from 8 October 1977 through 26 January 1978. In January the air-to-water heat exchanger froze and DHW preheating was discontinued.

44584 (SERI/TP—49-063, pp 63-68) **Arlington solar house of the University of Wisconsin, Madison.** Erdmann, D.R.; Persons, R.W. (Univ. of Wisconsin, Madison). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Arlington House, located near Madison, Wisconsin, is heated by solar and off-peak electric auxiliary energy. The collectors are air-heating Owens-Illinois (OI) evacuated tubes, and the air handler is a modified Solaron unit. The rock bed stores auxiliary energy, and so has double the capacity that is required for the usual air system. Hot water is provided by an air-to-water heat exchanger in the collector loop. While the heating system is experimental, the building serves as a residence for a rural family. It has been in routine operation for the past winter, and a body of practical experience on the collectors and the system has been accumulated. The system is extensively instrumented, and complete operating data are available for 92% of the period from December 1977 through April 1978. These data have been processed to provide measures of the total loads, solar contribution, and behavior of the components and system. Except for minor mechanical failures, the system functioned well, and kept the house comfortable through the winter. The solar contribution was less than predicted. Problems included thermosyphoning, maldistribution of flow in the rock bed, and snow accumulation on the collectors.

44585 (SERI/TP—49-063, pp 79-84) **Performance of a residential scale solar heating system.** Leverenz, D.J.; Joncich, D.M. (Construction Engineering Research Lab., Champaign, IL). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The performance of a residential scale solar heating system located at the Construction Engineering Research Laboratory, Champaign, IL, for the period January 1977 through April 1978, is described. The solar system consists of 220 ft² (20m²) of flat plate selective surface, singly glazed solar collectors and a 2,000 gal (7.6 m³) hot water storage tank. The storage system supplies hot water for heating a 540 ft (50 m) building used by the Construction Engineering Research Laboratory as office space. There is no domestic hot water in the building. Auxiliary energy is supplied by an electric, flow-through hot water heater. The solar system is completely instrumented. An analysis of the system operation in terms of mean daily averages for each month of two heating seasons is presented. The data include instantaneous solar radiation (horizontal and in the plane of the collector), useful heat acquired by the collector, useful heat delivered to the thermal storage tank, useful heat delivered to the heating load, thermal storage heat losses, and electrical energy supplied to the pumps. In addition, a daily profile of the performance of the system is presented for a representative sunny winter day. An analysis of the solar system operation indicated that, in considering the process of converting incident solar energy into useful heat, the collector array is, by far, the most inefficient component in the system.

44586 (SERI/TP—49-063, pp 87-92) **Performance of the USAF Academy Solar Test House: a retrofit application.** Eden, A.; Tinsley, J.T. (USAF Academy, CO). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The performance of the USAFA Solar Test House since its start of operational research in December, 1975 is discussed. This house is unique in that it is a retrofit application of solar energy systems to a typical military family housing unit. The data gathered through the numerous sensors and microprocessor system includes all the typical information required to evaluate the performance in a very accurate research oriented environment. Results illustrate the effects of the various parameters on system performance to include storage tank volume, collector tilt variation, collector fluid flow and control temperatures. In addition, thermographic studies for improving collector system performance and spotting problem areas are discussed. Finally, the difficulties faced with start up and initial operation are listed and the solutions to those problems are evaluated.

44587 (SERI/TP—49-063, pp 103-109) **Thermal performance evaluation of the Reedy Creek utilities solar energy system.** Wallace, C.T. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

A performance evaluation of the Reedy Creek Utility solar energy system in Lake Buena Vista, Florida, for the period March through August, 1978, is presented. The system is described briefly including its principal modes of operation. Unique design and installation features of interest to others considering solar energy systems are highlighted. The evaluation includes a comparison of the design performance of the system with its measured operating performance. In support of this, the long term average climatic data are compared with that taken at the site during the report period. The system provided 100 percent of the domestic hot water requirements and 34 percent of the space cooling demand during the report period. Space heating was not required.

44588 (SERI/TP—49-063, pp 111-116) **Solar heating and cooling results for the Los Alamos Study Center.** Hedstrom, J.C.; Murray, H.S.; Balcomb, J.D. (Los Alamos Scientific Lab., NM). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Solar energy system performance data for one heating season and two cooling seasons are given for the Los Alamos National Security and Resources Study Center, a 60,000 ft² conference center and library at the Los Alamos Scientific Laboratory, New Mexico. The solar energy system for the Study Center consists of an 8000 ft² array of selectively coated, single-glazed collectors, a 5000 gallon pressurized tank for hot storage in the cooling mode, and a 10,000 gallon tank, which is used for hot storage in the heating mode and cold storage in the cooling mode. Either of two chillers may be used in series with the cold storage tank, an 85 ton absorption unit, or a 77 ton Rankine cycle unit. Night evaporative cooling is also used to cool the 10,000 gallon tank. A heat recovery unit is used to preheat fresh air in the winter, and, by means of spraying the exhaust air, to pre-cool fresh air in the summer. Daily, monthly, and seasonal energy summaries are presented for the system. Performance data for the two chillers include tabulation of thermal and system coefficients of performance. Discussions of system operating experiences are included, particularly of the development of optimum solar cooling strategies, which increased the solar cooling fraction from 81% in 1977 to 97% in 1978. The solar heating fraction for the system was 79%.

44589 (SERI/TP—49-063, pp 119-124) **Langley Systems engineering building; solar cooling and heating experience and performance.** Jensen, R.N. (National Aeronautics & Space Administration, Hampton, VA). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The performance of the NASA Langley's Systems Engineering Building (SEB) solar system is given. The system has been in operation since May of 1976. Cooling and heating is provided for a 50,000 square foot office building. It has a 12,660 square foot flat plate solar field driving a 174 ton absorption chiller. The system has seven different types of flat plate collectors. Excess energy is stored in a 30,000 gallon water tank. A mini-computer is used for data reduction. The dynamic effect of the system is detailed as well as the yearly data. The system uses thermal energy from the solar field at 160° to 205°F for about 57-percent of the annual thermal energy required by the building.

44590 (SERI/TP—49-063, pp 149-155) **Performance evaluation of the Trinity University solar energy system.** Crum, J.W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Trinity University solar energy system in San Antonio, Texas, is described. A performance evaluation of the system is presented, and its four modes of operation are described. The system provides space heating, space cooling, and domestic hot water to an athletic complex and six dormitories. System performance is assessed using an analysis program which computes performance factors based on 94 different measurements monitored continuously at the site. The performance of each subsystem is evaluated by comparing the total energy load with the solar energy contribution. Significant results related to storage performance, domestic hot water performance, and energy losses are included. Preliminary results of collector and space heating subsystem performance are also given.

44591 (SERI/TP—49-063, pp 157-166) **Operating experience from the Santa Clara Community Center - solar energy system.** Anderson, L.B. (Acurex Corp., Mt. View, CA); Ayraud, S. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

To demonstrate the feasibility of solar driven cooling, the City of Santa Clara and the National Science Foundation have added a solar-powered air-conditioning, heating and domestic hot water system to the City Community Center. The solar energy

system includes flat plate solar collectors, absorption cycle water chillers and hot and cold storage. The system has operated successfully since March of 1977. An extensive data acquisition system has been installed to evaluate the solar energy system's thermal performance and the practical aspects of this form of solar energy utilization. This paper presents data and analysis results obtained by the University of Santa Clara. These studies show overall agreement between actual results and predictions; however, this agreement is shown to be fortuitous. Comparison studies have been made between the existing system and three alternate system designs including a conventional, non-solar design utilizing an electric vapor compression chiller. These studies have shown that, during the cooling season, the existing solar energy system uses more fossil fuel energy than the conventional system would use, suggesting that fossil fuel displacement should be taken into account at the system design level.

44592 (SERI/TP—49-063, pp 169-178) **Thermal performance of the Kalwall Corporation warehouse passive solar space heating system.** Weston, M.W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Kalwall Corporation passive solar energy space heating system is briefly described, and the results of a thermal performance evaluation of the system covering the period from November 1977 through August 1978 are presented. The technique used for passive solar space heating thermal performance evaluation is presented as it applies to the Kalwall Corporation solar energy system. Performance results, presented for both winter and summer operation, show that system operation met design thermal performance goals. Energy savings data are presented for the building and compared to conventional building design. In each case, substantial savings of conventional energy resources were realized.

44593 (SERI/TP—49-063, pp 187-192) **Performance and operating experience for the New Mexico Department of Agriculture solar heated and cooled building.** Fenton, D. (New Mexico Solar Energy Inst., Las Cruces); LaPlante, D.; San Martin, R.L.; Diamond, S.; Packard, C.; Shaw, H.; Stevens, W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The New Mexico Department of Agriculture (NMDA) building was first occupied in October of 1975. An instrumentation system was designed and installed on the NMDA building to monitor the performance of the solar system. Actual performance data for the full heating mode include the 1976—77 winter heating season. The reduced data indicate that the heat load fraction contributed by the solar system is unity. Solar system performance during full cooling was evaluated for the month of August 1977. The solar fraction of the cooling load was calculated to be 30 percent including parasitic electrical energy.

44594 (SERI/TP—49-063, pp 201-206) **Lessons learned on solar system design problems from the HUD solar residential demonstration program.** Sparkes, H.R.; Raman, K. (Dubin-Bloome Associates, NY). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

What has been learned about design problems and design errors in solar systems, based on the operational experience gained from the solar installations in the HUD solar residential demonstration program, largely from the first three cycles and to a smaller extent from projects in the fourth cycle, is discussed. The design problems discussed include problems in overall system design, subsystem design and selection, and component selection, and will be grouped into the following categories: problems in design methodology; collector-related design problems; storage design problems; distribution system problems; control system problems; and overall system design problems. Examples are outlined.

44595 (SERI/TP—49-063, pp 209-211) **Installation and operation problems encountered in residential solar systems.** Abrams, D.W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

In reviewing the field experience of one company involved in the manufacture and distribution of solar energy equipment, several common problems may be isolated and addressed. During the past two years, Southeastern Solar Systems, Inc. has placed in excess of two hundred residential solar and woodburning space heating and DHW systems in the United States. Data are available on sixty-five of these systems. All utilize medium temperature, flat plate collectors in a liquid system with water storage. A summary of the most common problems encountered during the installation, start-up and operation of these systems is presented. Most such problems were observed to stem from a lack of basic construction skills and failure on the part of installers to translate training and instruction into practice. Additional problems arose when what were perceived by the installer as minor modifications were made to standard system designs. In the preponderance of all cases, consultation with the manufacturer's Engineering Staff facilitated a solution and satisfactory system operation. Future efforts will be directed towards more comprehensive and effective installer training.

44596 (SERI/TP—49-063, pp 213-217) **Hardware problems affect the performance of solar heating and cooling systems.** Cash, M. (Marshall Space Flight Center, AL). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Many mistakes are being made in the design, production, and installation of solar heating and cooling systems. A large number of these can degrade the performance of the system and increase the payback period. Others can shorten the lifetime of the system or increase the cost. Sometimes, the designer and owner may not be aware of these. The hardware problems that affect performance and lifetime, and the corrective action, are described. It is intended to help ensure the installation of efficient solar heating and cooling systems that will perform as expected.

44597 (SERI/TP—49-063, pp 219-220) **Cost-effective ways to improve the fabrication and installation of solar heating and cooling systems for residences.** Thayer, S.B. (Colorado State Univ., Fort Collins). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The study observed twelve residential solar heating installations in Colorado and Arizona and recorded those installations by means of time-lapse photography and group-time study. The finds of the project were derived from an analysis of the time study and photographic data and from observations and discussions with installation personnel and manufacturers representatives. Typical findings were the lifting of collectors onto the roofs of buildings by means of a light duty cherry picker type boom crane is more cost-effective than using either manual lifting or a heavy duty construction crane.

44598 (SERI/TP—49-063, pp 227-230) **Solar system start-up and operational concerns.** Brooks, J.; Easterly, J.; Rickard, J.S.; Statt, T. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Solar energy systems present many novel problems to the consulting engineer. Many of the problems that plague solar systems do not manifest themselves during the design process. It is not until the start up and operational phases of a solar project that these problems begin to materialize. In general, they are practical problems that could have been prevented through good engineering practices and careful foresight, but are somehow overlooked. Solar systems seem to be particularly susceptible to these oversights. Examining start-up and operational concerns can serve two purposes: (1) we can site problems that can be identified and solved during these phases of a solar project and (2) we can learn ways to avoid problems through better and more thorough design.

44599 (SERI/TP—49-063, pp 233-237) **Solar system design and installation concerns.** Weinstein, S.D. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Having performed over 100 design reviews during the last eighteen months, the Ehrenkrantz Group has had the opportunity to witness, firsthand, the types of physical problems solar designers have been confronting in the design of solar energy systems. Experience has included both the review of contract documents and on-site inspection of these facilities. In addition, many projects were designed independently of that contract. The physical (rather than the mechanical, electrical or structural) aspects involved in the design and installation of solar systems are discussed. The typical physical factors and problems encountered in design are addressed. In addition, the cost-effectiveness of various details is considered.

44600 (SERI/TP—49-063, pp 239-243) **Two year evolution in solar heating and cooling equipment configurations and installation techniques.** Hudson, W.T. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Much has been done in the past two years in developing solar system configurations to reduce the cost of installation as well as minimize the risk of installation cost overrun. Additionally, diagnostic equipment is being added to the solar system to facilitate installa-

tion and maintenance operations. These developments in solar system equipment configuration have assisted in reducing installation and maintenance cost. An example of how such innovative techniques have affected the installation time of solar systems is a recent Mid East project where a three-ton air conditioning system was installed and made operational in 36 hours. The 324 man-hours required to install and make the solar air conditioning system operational is a substantial reduction from what was required just a short two years ago, when the equivalent man-hour requirements were between 1500 to 2000 hours. The proof that this was not an isolated incident rests in the fact that another 3-ton solar air conditioning installation was recently completed in less than 500 man-hours. The development work in the area of system packaging, tests and evaluation diagnostics, and maintenance/troubleshooting equipment is reviewed from the typical equipment provided and used on PON 1 and HUD Cycle 1 through PON 2 and HUD Cycle 3. The systems under review include space heating and domestic hot water as well as air conditioning systems in the residential to the larger commercial units including 3, 25 and 100 ton systems. An overview of the remaining work required to prepackage solar systems for further installation cost reduction reduces the risk of cost overrun, and further simplifies the trouble shooting and maintenance operations provided.

44601 (SERI/TP—49-063, pp 245-250) **Freezing problems in operational solar demonstration sites.** Chopra, P.S.; Wolosewicz, R.M. (Argonne National Lab., IL). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

As part of the National Solar Demonstration Program, Argonne National Laboratory is obtaining and evaluating reliability and maintainability information as well as material performance data from solar demonstration sites. Based on a review of 47 operating solar demonstration sites, the reasons that freezing occurred at approximately 30% of these sites are summarized. These data indicate that water-glycol systems provide more reliable freeze protection than water systems as long as an adequate glycol concentration is installed initially and then maintained. The freezing problem in water systems is more complex and can, in part, be attributed to: freeze detection sensor location, power failures, manifold slope, leaking control valves, frozen or improperly located vent valves, and a direct connection of the city water mains to the thermal energy storage tank. The preceding considerations indicate more stringent component reliability requirements are needed for a water system than for a water-glycol system. The freezing potential of air collector systems with a domestic hot water preheat option is directly affected by the air damper leakage rate. With proper damper selection, installation, and inspection as well as proper maintenance of the louver seals, this freeze problem can be avoided. Guidelines for avoiding the freezing problem at future solar demonstration sites are presented.

44602 (SERI/TP—49-063, pp 253-258) **Lessons learned on solar system installation, operation and maintenance problems from the HUD solar residential demonstration program.** Sparkes, H.R.; Raman, K. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

What has been learned about problems arising in solar system installation, operation and maintenance, based on the experience gained from the solar installation in the HUD solar residential demonstration program is discussed. The problems discussed include the following areas: collector system problems, storage problems, distribution system problems, control system problems, problems relating to roofing, plumbing, etc. and institutional problems. Examples are given briefly, to the extent that space permits.

44603 (SERI/TP—49-063, pp 267-271) **Cost, performance, and reliability patterns of solar heating systems: an assessment by 177 owners.** Sawyer, S.W. (Univ. of Maryland, College Park). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

A survey of 177 owners of active solar domestic water, space and combined water and space heating systems was conducted to determine their experiences, attitudes, and assessments. None of these solar consumers was subsidized or involved in a solar research or demonstration project. The other parameters of the research design required that the consumers have single family homes, be the owners throughout the adoption process, have purchased their system in or since 1973 and live in New England or the Southwest. The system cost and technical malfunction experiences of these consumers are discussed. These experiences indicate a great diversity in system cost whether presented on an aggregate basis or disaggregated by function and manufacture. The cost per square foot of collector area averaged $22 and ranged from $35 for packaged space heating system to $9 for homemade combined systems. The technical malfunction experiences of the consumers indicate problems in over 50% of the systems in the initial three months of use and over 40% of the systems after this period. The control systems were the most frequent problem.

44604 (SERI/TP—49-063, pp 279-283) **Cost data collection from solar demonstration projects.** King, T.A. (Mueller Associates, Inc., Baltimore, MD); Kirkpatrick, R.E. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

An historical perspective on the task of collecting construction cost data from the projects in the National Solar Heating and Cooling Demonstration Program is given. Most importantly, it describes the level of detail and accuracy of construction cost data that can be derived from these projects. Accurate cost data on solar demonstration projects have been difficult to obtain in the past, but are now being made available in Solar Project Cost Reports as part of the National Solar Data Program. The present approach to and rationale for the cost data collection procedure are described. In addition, the type of data that were previously sought and the operational problems that were encountered in obtaining that data are discussed. Cost data are essential for the evaluation of the economic performance of the solar demonstration projects. The cost information is also needed by others within the solar infrastructure.

44605 (SERI/TP—49-063, pp 285-292) **Analysis of the construction cost of ten non-residential solar energy systems.** King, T.A. (Mueller Associates, Inc., Baltimore, MD); Moore, J.S.; Hale, H.J. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

As part of the National Solar Data Program, Mueller Associates, Inc. under subcontract to the Argonne National Laboratory has collected, analyzed and reported construction costs data for ten operational instrumented solar energy demonstration projects. The cost data were obtained during visits to the sites, discussions with system designers, construction contractors and owners and review of DOE vouchers. A Solar Project Cost Report has been prepared for each of the ten projects. Some of the results of analyses that were performed to determine major cost factors and their impacts on construction costs for these ten solar energy systems are described. The impacts of the following factors are among those investigated: solar system and subsystem design, physical condition of the site and building, aesthetic requirements, taxes, construction delays (many types), contractual configuration, prepurchasing major equipment items, size of the project, and new vs retrofit installations. Trend data for different solar energy system types are presented along with a discussion of the reasons for the indicated cost ranges. Subsystem costs are presented as a percent of total solar energy system cost and also in terms of dollars per square foot of collector area. The analysis discussed will be of use in developing cost estimates of solar energy systems, in performing economic analyses, and in determining the overall economic performance of similar systems.

44606 (SERI/TP—49-063, pp 303-306) **National solar heating and cooling evaluation system.** DeLima, H.; Hirshberg, A.; Dick, C. (Booz-Allen and Hamilton Inc., Bethesda, MD). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Federal Government is playing an increasingly important role in monitoring the development and growth of the solar heating and cooling (SHAC) market. Various incentives to promote growth of the solar industry are being discussed by Congress and by the Department of Energy. Federal solar programs and incentives analyses would be strengthened if the cost, performance, and installation problems (if any), associated with SHAC installations, were monitored and systematically evaluated on a regular basis. In order to be able to make more informed decisions, analyses are needed of the cost and performance of installed and operational SHAC systems, as well as an understanding of the impact of various incentives and barriers to the implementation of solar energy. The work completed during the first of a three-phased project funded by the Department of Energy (DOE) to design, test, and implement a system of data collection and analysis concerning nonfederally-funded solar heating and cooling (SHAC) installations located throughout the country is described.

44607 (SERI/TP—49-063, pp 315-322) **Electricity and gas consumption of 24 solar homes compared with 26 conventional homes having identical heating loads.** Ward, J.C. (Colorado State Univ., Fort Collins). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

All 50 of these homes are located in a subdivision in Denver, Colorado. The solar homes were designed to provide about 68% of the annual space-heating and hot-water energy requirements. While gas costs for the solar homes were less, the electricity costs were greater. However, the total energy costs for the solar homes are about the same as those for the conventional homes. When one considers maintenance costs of the solar heating systems, the solar homes are about $80 to $90 more expensive to operate per year. The solar homes each saved 5.89 million Btu of natural gas per month at the expense of 0.53 million Btu of electricity. But it required 2.11 million Btu of fossil fuel to provide this electricity, so the net fossil fuel savings averaged 3.77 million Btu per month per solar home. The average price paid per Btu of gas and electric energy for the solar homes were greater than for the conventional homes. Solar energy supplied 40% of the space heating and hot water heating requirements. The solar system collected 22% of the incident solar energy. Total fossil fuel energy requirements of the solar homes was 84% of the fossil fuel energy requirements of the conventional homes.

44608 (SERI/TP—49-063, pp 335-340) **Operation of six different solar retrofit systems in single family residences.** Remmers, H.E. (Remmers Engineering, Boulder, CO); Tonelli, A.L. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Test results for the first four months of solar system operation at the Littleton, Colorado solar site owned by the Littleton Housing Authority (LHA) are presented. The site consists of ten single family residences (SFR), six of which are equipped with solar systems that represent state-of-the-art, commercially available equipment for space heating and domestic hot water (DHW). Test data collection began on June 1, 1978. Since data are available only for the summer months (June through September), the performance results presented are only for the DHW portion of the test program. A review of the test program shows that: (1) the liquid-based systems were easier to install than the air-based systems; (2) significant installation and operational problems have affected the performance of all six systems; (3) the liquid DHW system has demonstrated the best performance for DHW heating; the other systems have not proven cost effective; and (4) maintenance contracts are a necessary part of any solar installation made in public housing.

44609 (SERI/TP—49-063, pp 343-347) **Experiences realized with air and liquid space heating systems during the past three years.** Winn, C.B. (Solar Environmental Engineering Co., Inc., Fort Collins, CO); Parkinson, B.W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Information concerning the performance and maintenance problems associated with two solar houses that were built as part of the first cycle of the HUD demonstration program is presented. Both solar systems provide space heating and service hot water; one system is an air system while the other system is a liquid system. The air system is of conventional design and is typical of many of the solar systems that have been designed and installed over the past three to four years. Specific details on problems that have been encountered with the air system since it was installed are presented. Performance data to be presented include measurements of appropriate temperatures and air flow rates, and monthly fuel bills. Also presented are performance measurements obtained from an energy meter which is used to determine the amount of solar energy that has been collected. The liquid system is somewhat unconventional in that the space heating is provided by baseboard heaters. The problems that have been experienced with this system are discussed and design and installation improvements are suggested. Similar to the air system, performance data include measurements of appropriate temperatures and fuel bills. Both systems are located relatively nearby the Colorate State University Solar Energy Applications Laboratory. Consequently, climatological data obtained at the Solar Energy Applications Laboratory are considered to be valid for the two houses and, therefore, sufficient data are available for a reasonable determination of the performance of each of the solar systems for the past two to three years.

44610 (SERI/TP—49-063, pp 349-353) **Evaluation of solar energy control systems.** Bartlett, J.C. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The National Solar Heating and Cooling Demonstration Program, administered by the Department of Energy, includes solar energy systems located at various sites throughout the United States; the Virgin Islands and Puerto Rico. System design and climates vary widely among these sites some of which have been selected for performance monitoring under thee National Solar Data Program. The monitoring, evaluation and reporting of the thermal performance of these selected solar energy systems is being done by the International Business Machines Corporation. During the performance monitoring process, numerous systems have been observed in which the control system has caused abnormal or anomalous operation of the solar energy system. The abnormal operation of a solar energy system can significantly degrade the system's thermal performance and even cause system failure. Therefore, the control system's operation is critical to the overall performance of the solar energy system. Because of this criticality, observed cases of abnormal operation of the solar energy system which were caused by the control system have been evaluated. The causes of such anomalies are classified in the following three groups: (1) control sensor problems, (2) problems with controllers, and (3) problems with control actuating devices. Examples are given of each type along with the cause of the abnormal operation. Candidate solutions for control system problems are also given.

44611 (SERI/TP—49-063, pp 355-359) **Solar cooling of a Florida residence.** Hancock, O.G. Jr. (Florida Solar Energy Center, Cape Canaveral). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

A Florida residence, designed to be cooled and heated by solar energy, is described. The solar system cools using an Arkla 3-ton chiller, although system design was initially based on a modified Arkla 3-ton direct expansion air conditioner. Hot water storage is provided, but chilled water storage is not provided since the design was based on the direct-expansion air conditioner. The solar energy system is described in detail, including modes of operation and control logic statements. Data are presented which show the overall system performance and subsystems performance since May 1978. Other useful and qualifying data are presented, such as: incident solar radiation on the collectors; useful heat acquired by the collectors; useful heat delivered to storage; useful heat delivered to domestic hot water load; useful heat delivered to chiller; actual cooling accomplished; and solar fraction. The data are interpreted and compared with system design parameters. Conclusions are drawn and recommendations are made concerning use of design techniques and criteria as applicable to hot and humid areas of the south and southeast United States.

44612 (SERI/TP—49-063, pp 361-364) **SERI's role in solar heating and cooling.** Bishop, C.J.; Kreith, F. (Solar Energy Research Inst., Golden, CO). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Solar Energy Research Institute (SERI) is active in several areas of solar heating and cooling. SERI is responsible for developing and implementing the Systems Analysis, Test and Validation (SATVA) program. SERI has also been designated to become the lead institution for solar cooling R & D with full responsibility for this task to be transferred to SERI in 1981. At present SERI is only responsible for the desiccant part of the DOE cooling program. The national solar passive program is now under the direction of SERI's Technology Commercialization Division. Lastly, material research is underway on the reliability and lifetime of glazing; durability of low cost absorber materials; and corrosion studies of flat plate collector systems. The SATVA and desiccant programs are discussed.

44613 **Combination structure and greenhouse utilizing indirect solar energy.** Marschner, W. US Patent 4,141,498. 27 Feb 1979. Filed date 31 Oct 1977. 8p.

A combination multi-story greenhouse and structure in which the sun's rays are utilized to heat water is disclosed which is thereafter stored to be circulated when needed throughout the structure is disclosed. Indirect heat exchange to maximize use of heat values is also employed. The greenhouse has a first upper roof and side structure designed to best capture the angle of the sun's rays and a second lower roof adapted to receive and transfer heated water. The sun's rays are utilized to enable the growth of plants and in this capacity may be utilized even near the bottom of the greenhouse by use of reflecting means. Heat coincident with the passage of the sun's rays is transferred into water by means of spraying water from nozzles on the underside of the upper roof of the greenhouse and collecting the water on the top of the bottom roof of the greenhouse. Heated water thus collected is circulated into the basement through a heat sink and into a water storage area. Rain water is collected from the roof of the non-greenhouse structure and is conveniently utilized as the water supply for the system. Overflow means are provided to disposed of excess rain water which might collect on the roof. Though the greenhouse is only one story tall, the exterior building structure is multi-floored and, at the juncture of the floors with the wall of the greenhouse, radiators are disposed around the perimeter of the greenhouse to allow heat previously collected and stored as heated water to be used in heating the structures.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 44624

44614 (COO—4546-13) **Treatment of meat processing wastewater. Non-equilibrium carrier effects on solar cell performance.** Miller, B.F.; Ferry, D.K. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 7p. Dep. NTIS, PC A02/MF A01.

The study showed that solar heating the wastewater to any temperature above normal did not significantly improve its COD (chemical oxygen demand) content. A closed form solution of the Boltzmann transport equation utilizing the Levinson—Kurosawa formalism has been used to solve for the carrier distribution function in n-type silicon under AM2 solar radiation. (MHR)

44615 (PB—286940) **Use of solar energy to heat anaerobic digesters. Part I. Technical and economic feasibility study. Part II. Economic feasibility throughout the United States. Feasibility study, 5 November 1975-1 June 1976.** Malcolm, J.W.; Cassel, D.E. (Environmental Systems, Inc., Annapolis, MD (USA)). Jul 1978. Contract EPA-68-03-2356. 99p. NTIS PC A05/MF A01.

Two distinct, yet related studies were conducted to determine the technical and economic feasibility of using solar energy as the source of heat for the anaerobic digestion process. Retrofitting a solar energy collection and heat transfer system to a digester at Annapolis, Maryland was proven feasible in the first part of the study and the concept of using solar energy for digester heating throughout the United States, including Fairbanks, Alaska, was shown to be economically feasible in the second part of the study. The Part I study compared five (5) types of flat plate collectors and selected the cost effective design to supply approximately 90 percent of the heat load to maintain digester operating temperatures of 32C to 38C. Three flat plate collectors of varying efficiencies were evaluated for use at numerous locations in the United States. The study showed that optimum-sized flat plate collectors can provide from 82 to 97 percent of the total annual digester heat, the higher percentages being applicable to areas of higher solar radiation. The Part II study developed specific guidelines for determining the optimum size and conceptual design for a solar heating system for any size sludge digester at any location.

44616 (SERI/TP—49-063, pp 133-139) **Thermal performance evaluation of the Aratex Services, Inc. solar energy hot water system.** Armstrong, H.L. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

A thermal performance evaluation of the ARATEX Services, Inc. solar energy system is presented. ARATEX is an industrial laundry in Fresno, California, with an average hot water demand of over 30,000 gallons per day at a demand temperature of 180°F. In addition to the solar energy system, the laundry also has a heat recovery system which utilizes energy from the laundry's waste water to preheat the water entering the solar energy system. Both the heat recovery system and the solar energy system are briefly described. The thermal analysis includes determination of collector efficiency, storage efficiency and load subsystem performance. The heat recovery system reduced the hot water load at the laundry by 34 percent. Of the remaining load, 19 percent were satisfied with solar energy.

44617 (SERI/TR—35-047) **Technology development needs for high temperature process heat.** Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1978. Contract EG-77-C-01-4042. 62p. Dep. NTIS, PC A04/MF A01.

This study investigated the potential utilization of high temperature solar thermal process heat. The objective was to identify process specific problems and development needs. The petroleum industry was reviewed in some detail, and one candidate technology using hydrogen for energy transport was also investigated. Costs, land availability, and energy transfer were the key problem areas. With appropriate development all problems appeared solvable. More detailed evaluations of each large energy user industry were recommended.

WATER HEATING

REFER ALSO TO CITATION(S) 44573, 44574, 44579, 44580, 44581, 44582, 44583, 44584, 44587, 44590, 44591, 44593, 44594, 44595, 44596, 44597, 44599, 44602, 44603, 44604, 44605, 44606, 44607, 44608, 44610, 44611

44618 (SERI/TP—49-063, pp 13-18) **Thermal performance evaluation of the A-frame Industries solar energy hot water system.** Nemetz, D.L. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The performance of the A-Frame Industries solar energy domestic hot water system for a single family dwelling in Kaneohe, Hawaii, is evaluated based on a comparison of the predicted climatic, load and operational conditions with those measured at the site. The solar energy system and instrumentation are described, along with the method of gathering data for performance computations. Performance parameters are extrapolated for increased hot water consumption based on f-Chart projections. Although the system supplies 100 percent of the present domestic hot water load, the load must be increased before the system can realize its economic worth.

44619 (SERI/TP—49-063, pp 31-38) **Thermal performance evaluation of the Facilities Development solar energy hot water system.** McCumber, W.H. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Facilities Development solar energy system in San Diego, California, and its modes of operation are described, and a performance evaluation of the system based on instrumented data collected during the period March through August, 1978, is presented. The evaluation is based on comparison of predicted climatic, load and operational conditions with those measured at the site. These data are analyzed to produce an evaluation of the system performance. During this reporting period, the climatic conditions did not vary significantly from the long-term averages, thus the system's performance over the period is representative of the long-term expectation. The Facilities Development solar energy system provided 37 percent of the domestic hot water energy requirements for the 31-unit condominium. However, 39 percent of the collected energy was lost during transport and storage operations.

44620 (SERI/TP—49-063, pp 71-76) **Long term performance of a residential solar water heater.** Mastronarde, T.P. (Combustion Engineering, Inc.); Bowley, W.W. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Performance results for the first three years of operation of a solar water heater installed to supplement an electric water heater in an existing residence in Connecticut are presented. Continuous monitoring of hot water load, water supply temperatures, electrical energy consumption, and operating time has been maintained over this time period. In addition to mean daily averages and seasonal profiles of solar performance, a comparison of yearly performance values for total energy used, the useful solar energy delivered to domestic hot water, the number of hours and number of days of operation per year are presented. From this data, yearly average rates of solar energy delivered to hot water and the monetary value of this energy are derived. The monitoring techniques found suitable for this long term performance study and the degree of confidence in the data collected are presented. A brief discussion of the economic viability of solar water heaters in the Southern New England region is included. The experience gained in this study indicates that solar augmentation of domestic hot water is at best of marginal economic viability in New England under current constraints.

44621 (SERI/TP—49-063, pp 127-131) **Thermal performance evaluation of the Hogate's Restaurant solar energy hot water system.** Aquila, V.S. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Hogate's Restaurant solar energy system in Washington, D.C., is briefly described; and a thermal performance evaluation of the system is given. This evaluation includes comparison of predicted load and operational conditions with those measured at the site. Analytical techniques for measuring various thermal contributions are presented. Factors unique to Hogate's Restaurant which contributed to a high storage efficiency and the resulting solar contribution to the system load are discussed. Finally the savings attributed to the solar energy system when compared to a conventional system are also given.

44622 (SERI/TP—49-063, pp 141-146) **First year performance Argonne Children's Center Solar Water Heater.** Dierauf, E. (City College of San Franciso, CA). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The performance of the Argonne Children's Center Solar Water Heater is analyzed during its first 9 months of operation. Flat plate collectors (120 ft^2) preheat about 200 gallons of water each day that is stored in a 120 gallon tank connected in series to an existing conventional gas heated system. Readings of water and gas meters,

strategic temperatures, and circulation pump on-off time were made on a daily basis. Analysis shows that with minimums in December and maximums in May the average monthly storage tank temperature varied from about 80 to 125°F. The average daily time the pump operated each month varied from slightly more than two hours to slightly more than eight hours. Actual useful system heat output from solar varied from about 340 to 1100 Btu/day per square foot of collector. System efficiencies varied from about 30 to 80% based on temperature change alone and from about 20 to 50% based upon calculations using actual gas consumption. Savings in fuel consumption will amount to about $55 for the first year from this $4500 investment. Freeze control need and dangerous high temperature situations were not observed.

44623 (SERI/TP—49-063, pp 195-199) **Operational results from a solar hot water system installed in an interstate highway visitor center.** Jackson, D.R. (Univ. of Connecticut Energy Center, Storrs). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

The Connecticut Department of Transportation maintains Rest Area Visitor centers at a number of locations on the interstate highways passing through Connecticut. At one of these centers, located in Willington Connecticut on Interstate 86 Eastbound, a solar hot water system has been installed and has been operating since early July, 1978. The system is heavily instrumented and is being monitored by a 24 channel magnetic tape data logger with a one minute sampling rate. The objective of the project for the funding agency, the Department of Transportation, is to determine the feasibility of long term energy conservation through the use of solar augmentation for the entire rest area system. The unusual hot water use profile of such a facility, however, prevents reliance on a paper study using the F-Chart method for this feasibility determination. The rapid sampling rate of the data acquisition system provides an extremely detailed picture of the operation of the system under this widely fluctuating hot water demand, and insight into a number of interesting problems. Several months of accumulated, reduced data are available at this time. The experiment will run at least until September 1979 so that a full year of data is collected.

44624 (SERI/TP—49-063, pp 309-313) **Comparative evaluation of the thermal performance of solar energy systems.** Bartlett, J.C. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Comparative thermal performance evaluation of different solar energy systems is difficult due to system unique parameters and varying environmental conditions. A technique for comparing the thermal performance of a variety of operational solar energy systems by using a normalization procedure that reduces all systems to a common base is outlined. The examples of the parameters to be normalized are: insolation levels, loads, system size, etc. The technique is applied to comparative evaluation of three large hot water systems and results are presented based on the data collected via the National Solar Data Network during 1978.

OTHER

REFER ALSO TO CITATION(S) 44556

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 44531, 44545, 44548, 44569, 44597, 44599, 44601, 44602

44625 (CONF-761168—(Summ.), pp 5-14) **Thin films in solar energy utilization - a perspective.** Mattox, D.M. (Sandia Laboratories, Albuquerque, NM). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Some of the potential applications of thin films in solar energy utilization schemes are tabulated including their use as solar reflectors, infrared reflectors (solar transparent), solar selective absorbers, and active semiconductors for photovoltaic and photoelectrogalvanic uses. Existing fabrication technology is briefly reviewed. (WHK)

44626 (COO—2854-1) **Development and evaluation of thermic diode solar panels for building heating and cooling. Final report: November 1, 1975—October 31, 1977.** Buckley, S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Jul 1978. Contract EY-76-S-02-2854. 71p. Dep. NTIS, PC A04/MF A01.

This report covers research completed between November 1975 through October 1977 regarding various aspects of the thermic diode solar panel. Three specific aspects of the research are: market analysis, cost—volume study, and heat transfer analysis. The thermic diode solar panel is a passive solar energy system for space heating or domestic hot water heating. The thermic panel is also modular, has no moving parts, and is easily installed. Each panel contains all the necessary ingredients of a complete solar energy system: collectors, controls, storage, heat exchangers and ducting. In the market analysis, questionnaires were returned from about 80 building contractors throughout the country. Six barriers were identified which must be met for a solar heating system to be accepted by the marketplace (in order of importance): initial investment cost, operating cost, warranty period, number of successful installations, expected life, and payback period. The cost—volume study found the manufacturing costs of the panel at various production volumes. At the highest rate, 10,000 units/year, the factory price as delivered to the stie was about $6.00/ft^2. Heat transfer analyses, verified by experimental data taken on a scale model panel, showed how stratification of water in the panel's storage tank alters the flow rate.

44627 (COO—4557-1) **Materials for solar thermal conversion. Final report, September 1, 1977—August, 31, 1978.** Gittleman, J.I.; Sichel, E.K. (RCA Labs., Princeton, NJ (USA)). Sep 1978. Contract EG-77-C-02-4557. 21p. (PRRL—78-CR-42). Dep. NTIS, PC A02/MF A01.

Composite semiconductors were produced by cosputtering Ge and Si with CaF_2 and their optical constants were measured. Their optical behavior can be described as being similar to that of the parent semiconductor, with the same energy gap, but with a reduced, concentration-dependent index of refraction. The normal specular reflectance of films sputtered on mirrored surfaces was measured. These data were used to compute the solar absorptance α/sub s/ and thermal emittance ϵ/sub th/. It was found that α/sub s/ $\simeq$ 0.7 and ϵ/sub th/ $\simeq$ 0.06 with a weak dependence on composition, thickness, and operating temperature. Thus at T = 500°C a conversion efficiency of 50% is possible at solar concentration ratios C of 7 to 8, and about 70% is possible for C $\simeq$ 40. There is always a value of C above which a black body will exhibit a conversion efficiency larger than that of any other absorber. On the other hand, the question of the choice of absorber is an economic one depending not only on the solar conversion efficiency but also on the cost of land, capital costs of different types of systems, etc. Thus a parabolic trough, a distributed receiver with a concentration ratio of 50 or less could be more economical for some applications than a central receiver for which C > 500. While it is clearly a task for future research to seek ways of increasing the solar absorptance of the composite semiconductors and, hence, their versatility, the possibility of using these and other highly selective absorbers for the economical conversion of solar energy should be considered.

44628 (PNL—2953) **Plastics honeycomb core solar coverplate.** Gordon, N.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 32p. Dep. NTIS, PC A03/MF A01.

The feasibility of producing a solar collector coverplate by bonding two thin, transparent plastic skins to both sides of a honeycomb core was studied. A properly designed coverplate using this concept would result in a light-weight structural panel with lower heat losses than a typical two pane glass coverplate. A honeycomb core coverplate could be fabricated so that it would be as strong as a glass coverplate, yet, by the proper selection of skin materials, it could be made resistant to catastrophic damage from flying objects (i.e. hail, sticks, rocks, etc.). The reduced weight of this coverplate would be a significant advantage in reduced handling and shipping costs. (Two panes of 1/8 inch thick glass 3 feet by 8 feet weigh approximately 69 pounds. A Mylar honeycomb core of the same area with two skins of 0.025 inch thick glass reinforced polyester weighs approximately 9.5 pounds.) The consideration of different materials for the transparent skins and honeycomb core, details of fabrication, economic evaluation of the fabrication and distribution of the coverplate, and determination of the solar collector efficiency were covered.

44629 (SAND—79-1053C) **Experimental and theoretical evaluation of a novel concentrating solar energy collection system.** Maish, A.B.; Beard, J.T. (Virginia Univ., Charlottesville (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790541—3). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A new concentrating solar energy system was evaluated theoretically and experimentally at the University of Virginia Solar Test Facility. The modular, two-axis tracking collector combined an aluminized mylar reflector with a flat-plate absorber. Radiation collected from the 7 m^2 frontal area was concentrated by a factor of five, making the collector suitable for intermediate temperature applications. The thermal performance of the collector was deter-

mined theoretically on a digital computer using a nodal approach to model the heat transfer processes. Collector sensitivities to environmental parameters were calculated. An experimental testing program conducted according to the ASHRAE testing standards verified the predicted results.

44630 (SERI/TP—49-063, pp 95-100) **Test results for an evacuated tube transportable air solar heater.** Eno, B.E.; Felderman, E.J. (South Dakota State Univ., Brookings). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

A transportable solar forced air heater, developed under an ERDA contract, was retrofitted to a 900 square foot (83.6m²) house in Brookings, South Dakota, and performance tested during the latter part of the 1976—77 heating season. The solar heater includes a 96 square foot (8.9m²) evacuated tube type collector, rock storage, blowers, dampers and controls in a self-contained unit. Data analysis revealed a daily collector efficiency of 46.6 percent, substantially above most flat plate collectors. Collector efficiency appears to be relatively insensitive to operating temperature levels, remaining high at large ambient to absorber surface temperature differentials. Because of the absorber tube/reflector configuration, energy collection also remains high at large incidence angles. Overall solar system performance did not prove satisfactory, resulting in a relatively small solar energy contribution to the house heating. Energy losses from the heater were excessive, aggravated particularly by ambient air infiltration at the blower compartment. Other problems encountered were poor damper fit, electronic control failure and some absorber tube breakage. Nevertheless, high collector efficiency indicates good potential for this type of solar heating system.

44631 (SERI/TP—49-063, pp 273-277) **Solar system performance and component reliability after 5 years.** Goldberg, M.M. (Carborundum Co., Niagara Falls, NY). 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

Measured solar useful outputs of 300,000 Btu/ft²/yr in Southern USA and 200,000 Btu/ft²/yr in Northern USA are reported for air and hydronic, flat plate and concentrating evacuated tube solar collectors. Collector designs, in the author's opinion, should be compared on the basis of actual heat delivered in actual service over a period of varied weather otherwise false ranking of collector performance on the basis of laboratory condition testing is likely. Solar fluid viscosity at 15° and 70° is reported. Some fluids are easily pumped when cold, but others severely increase in viscosity. Solar heating can be used with confidence and performance results in reasonable payback periods.

44632 (SERI/TP—49-063, pp 325-332) **Comparison of actual collector array performance with predicted performance.** McCumber, W.H. 1978.

From Solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (29 Nov 1978).

In designing a solar energy system, the designer usually relies upon published instantaneous efficiency curves of a collector panel. However, the performance of collector arrays differs from that of a panel and under dynamic conditions the steady state panel efficiency curve does not adequately represent the collector performance. A comparison between actual dynamic performance of collector arrays in the field to the performance predicted by the steady state instantaneous efficiency model of a panel is given. The Hottel—Whillier—Bliss model is shown to produce deviations of over 100 percent from hourly measured performance and 35 percent from monthly measured performance. The actual energy gain (Qa) is calculated from data acquired by the National Solar Data Network. Then the operating point, calculated from the same time-coherent slice of data, is projected onto the steady state collector panel efficiency curve to arrive at a predicted energy gain (Qp). The error between the steady state operation of a solar panel and a dynamic representation of system performance is a measure of the accuracy of the Hottel—Whillier—Bliss model under dynamic operating conditions for the entire solar array.

44633 **Solar radiation energy concentrator.** Kaufman, L.I. Sr. US Patent 4,148,300. 10 Apr 1979. Filed date 1 Sep 1977. 12p.

A solar radiation energy concentrator is disclosed adapted to convert solar radiation into useful forms of energy, comprising a base member with a longitudinally extending hollow chamber, said chamber having an open end therein for admission of solar radiation therethrough; integrally affixed in said open end is a convex glass magnifying lens adapted to receive solar radiation impinging thereon and focus said radiation into a concentrated area on a heat absorbing sensor device located adjacent in that end of said chamber distal from the open end. The concentrator includes a heat exchanging system integrally juxtaposed with refractory lining on the chamber wall, for delivery of the energy input into the designated system.

44634 **Solar heating apparatus and mounting therefor.** Parlato, P. US Patent 4,148,296. 10 Apr 1979. Filed date 28 Nov 1977. 4p.

Solar heating apparatus is disclosed comprising units that can be assembled on roofs and outer side walls of buildings easily to give the buildings an aesthetic beauty.

44635 **Solar collector panel and method of making.** Scherber, W.; Dietrich, G. (to Dornier System GmbH). US Patent 4,148,294. 10 Apr 1979. Priority date 15 Apr 1976, German, Federal Republic of (F.R. Germany), 4p.

A solar collector panel is disclosed absorbing incident solar energy at a high rate while radiating only a small portion of the absorbed energy comprises aluminum or an aluminum alloy as a continuous metallic substrate carrying an anodized oxide layer not substantially thicker than 1 μ. The exposed anodized surface is formed with a multiplicity of pores receiving nickel rods of microscopic dimensions which project from the oxide surface. When the pores are spaced apart 0.1 to 1 μ and have a diameter of 0.1 to 0.5 μ, the nickel rods being dimensioned correspondingly, the panel has the desired properties.

44636 **Water-borne rotating solar collecting and storage systems.** Cluff, C.B. US Patent 4,148,301. 10 Apr 1979. Filed date 26 Sep 1977. 12p.

A water-borne solar energy collecting and converting system employing an azimuth-tracking, floating platform equipped with reflectors and associated thermal collector tubes is disclosed.

44637 **Solar sensor with linear concentration with a fixed receiver and movable mirrors.** Devin, B.; Guillemot, M. (to Commissariat a l'Energie Atomique). US Patent 4,148,564. 10 Apr 1979. Priority date 6 Jul 1976, France, 6p.

The solar sensor with a linear concentration comprises a system of elementary segmental mirrors arranged along the generating lines of a cylinder portion and directs the solar rays towards a zone located in the vicinity of a generating line of said cylinder and a receiver having a linear configuration arranged in said zone, wherein the receiver is stationary and means are provided for giving the mirror system a rotational movement without sliding so that the zone at which the reflected rays are directed remains fixed and the direction of the reflected rays remains unchanged when the sun's position changes.

44638 **Multi-layered solar energy collector.** Chieh-Tsung, C. US Patent 4,147,158. 3 Apr 1979. Priority date 24 May 1977, Taiwan, 4p.

A multi-layered solar energy collector is disclosed comprising a supporting means and a plurality of collector layers structured as part of coaxial cylinders or part of concentric spheres secured to said means whereby to absorb and utilize both the direct and scattering radiation of the sunlight to produce a high temperature thermal energy output.

44639 **Solar collector comprising an entrance window consisting of evacuated tubes.** Bruno, R.; Hermann, W.; Hoerster, H.; Kersten, R.; Klinkenberg, K.; Mahdjuri, F.; Bannigan, J. US Patent 4,144,875. 20 Mar 1979. Priority date 9 Apr 1976, German, Federal Republic of (F.R. Germany), 8p.

A solar collector is disclosed comprising a heat exchanger having a corrugated surface and an entrance window composed of evacuated transparent tubes respectively in contact with the corrugations.

44640 **Solar energy collector.** Kapany, N.S.; Hardy, E.E.; Orofino, T.A. (to Monsanto Research Corp.). US Patent 4,143,233. 6 Mar 1979. Filed date 6 Jun 1977. 8p.

A solar energy collector is described which consists of either a photoelectric cell or a heat-absorbing material mounted within a hollow concentrator. The photoelectric cell has the form of a rod of a monocrystalline element or compound with a generally cylindrical junction spaced at a distance radially inwardly from the outer surface of the rod. The photoelectric cell is mounted within a hollow transparent trough shaped concentrator or body which contains a liquid, e.g., water, which can be made to flow in order to both cool the photoelectric cell, thereby improving its efficiency, and to promote transmission of solar energy to the photoelectric cell by total internal reflectance. The heat absorbing material can be a metal pipe through which liquid can be made to flow to remove heat absorbed by the pipe, and preferably the pipe will be coated black on the outside surface to promote the absorption of heat into the pipe, and/or the liquid in the hollow transparent trough-shaped body can be made to flow over heat absorbing material to recover heat energy.

44641 **Solar radiation collector devices and systems.** Doughty, R.O.; Goodwin, D.W. (to General Dynamics Corp.). US Patent 4,142,511. 6 Mar 1979. Filed date 20 May 1977. 10p.

Solar energy collectors, devices and systems utilizing selective solar absorbers for more efficient collection of radiant energy from the sun and its conversion to useful form at relatively high heat transfer temperatures are disclosed. Each collector unit is made up solely of a closed shell-like enclosure having a continuous, unpenetrated boundary wall evacuated and hermetically sealed to form a structurally strong radiation collecting chamber whose boundary wall surrounds a rarified atmosphere environment such as a vacuum, the wall having a window portion which transmits substantially all of the received solar spectrum to a selective solar radiation absorber in the chamber and energy derived therefrom is collected at any energy collecting and transferring portion of the wall from which heat is conducted to the exterior. The chamber is wholly free of fluid passage or other structural means passing through the wall to provide a simple, long life, modular collector unit adapted to be independent of any necessary permanent connection to an associated heat transfer fluid or heat exchanger device. A high proportion of the solar radiation is absorbed in the chamber and converted to heat which can be transferred therefrom by heat conduction through the chamber wall to a heat transfer fluid moved externally over the wall. Plural collectors and their heat exchanger units can be operatively associated and interconnected to provide large area collector devices and systems.

44642 Optical properties and structure of amorphous silicon films prepared by CVD. Janai, M.; Allred, D.D.; Booth, D.C.; Seraphin, B.O. (Univ. of Arizona, Tucson). Contract ER-78-S-02-4899. *Sol. Energy Mater.;* **1**: No. 1-2, 11-27(Feb 1979).

Silicon films were deposited by pyrolytic decomposition of silane on substrates held at various temperatures, T/sub s/, in the range 550 to 800°C. The absorption coefficient, refractive index, and x-ray diffraction pattern of these films were determined. The films deposited at temperatures T/sub s/ $\leqq$ 660°C are amorphous, and their absorption profile resembles that reported in the literature for sputtered or evaporated amorphous films after long-time anneal. Films deposited on substrates at or above 670°C are partially crystallized, with particle size increasing gradually with substrate temperature. When the amorphous films are annealed, the resulting changes depend on length and temperature of the anneal. After a temperature-dependent induction period, the samples crystallize rapidly. The volume shrinks by $\sim$ 3%, as determined from the decrease in film thickness. The onset of crystallization is indicated first by a red shift of the absorption edge, which after further anneal is over-compensated by a blue shift. The results demonstrate that the superior solar absorptance of amorphous silicon can be utilized in photothermal solar energy converters of sufficient stability without sacrificing the advantages of CVD fabrication. 50 references.

44643 Design of selective surfaces for solar energy collection. Trotter, D.M. Jr.; Craighead, H.G.; Sievers, A.J. (Cornell Univ., Ithaca, NY). Contract EG-77-S-03-1456. *Sol. Energy Mater.;* **1**: No. 1-2, 63-68(Feb 1979).

Numerical calculations have been done to determine α/sub THS/, the total hemispherical solar absorptivity, and ϵ/sub TH/, the total hemispherical emissivity in the infrared, of selective surfaces composed of a dielectric film on a metal substrate. The selectivity of the surface as a function of n/sub L/ = n/sub L/ + ik/sub L/, the refractive index of the film, is discussed, as well as the effect of grading the index of the film. It is concluded that the most effective film is one having n/sub L/ as close to unity as possible through its entire thickness while k/sub L/ increases from zero at the front surface to a larger value at the back surface.

44644 Surface microstructure optical properties relationship in solar absorbers: black chrome. Ignatiev, A.; O'Neill, P.; Zajac, G. (Univ. of Houston, TX). *Sol. Energy Mater.;* **1**: No. 1-2, 69-79(Feb 1979).

The relationship between the surface microstructure and the optical properties of solar absorbing electrodeposited black chrome films has been studied by scanning electron microscopy (SEM), x-ray photoemission spectroscopy (XPS) and sputter depth-profiling techniques. The black chrome films have been determined to consist of a top layer of small ($\approx$ 400 A) Cr_3O_3 particles with one or two sublayers of larger ($\approx$ 1000 A) closely packed chromium particles. The optical properties of the solar absorbing films have been measured and analyzed via the spheroid model and it has been shown that the optical response of the particulate black chrome films is significantly determined by their microstructure. 20 references.

44645 Microstructure of a black chrome solar selective absorber. Lampert, C.M.; Washburn, J. (Univ. of California, Berkeley). *Sol. Energy Mater.;* **1**: No. 1-2, 81-92(Feb 1979).

The structure of Harshaw Chemicals' CHROM-ONYX type of black chrome/metal selective absorber was studied to gain a better understanding of its influence upon the mechanism of wavelength selectivity. Spectral reflectance measurements were performed on seven samples. In this study, the best selectivity was found by these measurements to be 1.0 μm of black chrome on copper and 0.7 μm of black chrome on nickel. Both transmission and scanning electron microscopy were employed to study microstructure and chemical composition. As a result of the combined studies, some effects of black chrome thickness and the metallic substrate were determined. It was found that black chrome consisted of a very fine metallic distribution of particles of chromium, possibly suspended within a matrix of an oxide of chromium. This combination was, in turn, agglomerated into larger particles within the 0.05 to 0.3 μm size range. These larger particles formed a network which constituted the surface coating.

44646 Composite semiconductors: selective absorbers of solar energy. Gittleman, J.I.; Sichel, E.K.; Arie, Y. (RCA Labs., Princeton, NJ). Contract EG-77-C-02-4557. *Sol. Energy Mater.;* **1**: No. 1-2, 93-104(Feb 1979).

Composite semiconductors were produced by cosputtering CaF_2 with either Ge or Si and measured their optical constants. Their optical behavior can be described as being similar to that of the parent semiconductor, with the same energy gap but with a reduced, concentration dependent index of refraction. The normal specular reflectance of films sputtered on mirrored surfaces was measured. These data were used to compute the solar absorptance α/sub s/ and thermal emittance ϵ/sub th/. It was found that α/sub s/ $\approx$ 0.7 and ϵ/sub th/ $\approx$ 0.06 with a weak dependence on composition, thickness and operating temperatures. Thus at T = 500°C conversion efficiencies of 50% are currently possible at solar concentration ratios C of 7 to 8 and about 70% for C $\approx$ 40 and improved performance can be expected with continuing research.

44647 Metal/insulator composite selective absorbers. Craighead, H.G.; Bartynski, R.; Buhrman, R.A.; Wojcik, L.; Sievers, A.J. (Cornell Univ., Ithaca, NY). Contract EG-77-S-03-1456. *Sol. Energy Mater.;* **1**: No. 1-2, 105-124(Feb 1979).

The optical properties of metal/insulator composite films have been examined, and their utilization as solar selective absorbers studied both theoretically and experimentally. Calculations have been made on the solar selective performance of graded composite films, demonstrating the performance and limitations to be expected for the general class of composite film absorbers. Design guidelines for the fabrication of optimum selective absorbers have been developed and subsequently implemented in the construction of selective absorbers using two promising composite materials, Ni/Al_2O_3 and Pt/Al_2O_3. Measurements of reflectance, solar absorptivity α, thermal emissivity ϵ, and high temperature durability have been made. The results show values of $\alpha \geqq 0.94$ for both Ni and Pt composite films. Values of $\alpha/\epsilon >$ or approx. = to 13 at 150°C were obtained for both composite materials when deposited on Cu substrates. A selectively absorbing film has been produced which shows no change in performance parameters after extended heating at 600°C in air.

44648 Hemispherical transmittance properties of solar glazings as a function of averaging procedure and incident angle. Pettit, R.B. (Sandia Labs., Albuquerque, NM). Contract AT(29-1)-789. *Sol. Energy Mater.;* **1**: No. 1-2, 125-140(Feb 1979).

The hemispherical transmittance properties of a variety of coated and uncoated plastics (teflon, tedlar, acrylic) and fiberglass composites (e.g., greenhouse coverings) were measured as a function of wavelength, polarization and incident angle. In addition the normal hemispherical reflectance for each sample was measured. The normal incidence data were solar averaged over an air mass two solar spectrum for the following cases: (1) an average over the solar energy spectrum as reported separately by Moon and Thekaekara to obtain a solar transmittance which is applicable to a solar thermal collector; (2) an average over the solar photon spectrum to obtain a solar transmittance which is applicable to a solar photon converter; and (3) an average over the solar photon spectrum which has been limited to the active wavelength region of several common solar cells. Solar energy transmittance values for the materials studied ranged from 0.95 to 0.77. The solar energy averages calculated using Thekaekara's data were from 0 to 3.5% lower than the averages calculated from Moon's data. Depending upon the material, the difference between the solar energy average and the solar photon average limited to the active range of a solar cell ranged from 1% to as much as 11%. The angular dependence of the solar transmittance was found to agree with calculations using a multiple beam transmittance model for materials that have very little scattering in the transmitted beam. However, for materials with appreciable scattering in the transmitted beam, differences between calculated and measured angular transmittance values as large as 0.04 transmittance units were found using this model.

44649 Measurements of the total transmittance of the solar radiation through an absorbing black liquid water. Huang, B.J.; Nieh, S. (National Taiwan Univ., Taiperi). *Lett. Heat Mass Transfer;* **6**: No. 1, 57-60(Jan 1979).

Black liquid is frequently used as a working fluid to directly absorb the solar radiation in solar energy applications. A typical example is by Minardi and Chuang who developed a black liquid

solar collector which uses a highly absorbing black liquid circulating in a transparent plain channel to directly absorb solar radiation. In this collector, a small fraction of the incident solar radiation energy is first reflected and absorbed by the transparent channel wall, and the remaining fraction is then transmitted across the black liquid at which the radiation energy is absorbed. It is obvious that the magnitude of the radiation energy absorbed is dominated by the overall absorptance or transmittance of the black liquid which depends on the black ingredient concentration and the depth of the liquid. Little has been known about the radiation properties of the black liquid up to date. To study the problems of water quality and thermal pollution in lakes, reservoirs, and rivers, Viskanta and Toor and Snider Viskanta carried out some analytical and experimental investigations on the radiative energy transfer in layer of pure water in which water is considered as an absorbing, emitting, and scattering body, and a rather complex analytical model is developed to predict the heat transfer behavior. However, literature on the behavior of radiant energy transfer in a black liquid are still lacking. An experiment is therefore carried out to study directly the total transmittance of the solar radiation through layer of black liquid water.

44650 Non-tracking solar energy collector system. Selcuk, M.K. US Patent 4,122,833. 31 Oct 1978. Filed date 27 May 1977. 8p.

A solar energy collector system is described. It is characterized by an improved concentrator for directing incident rays of solar energy on parallel strip-like segments of a flatplate receiver. Individually mounted reflector modules of a common asymmetrical triangular cross-sectional configuration supported for independent orientation are asymmetric included with vee-trough concentrators for deflecting incident solar energy toward the receiver.

44651 Method for making an aluminum or copper substrate panel for selective absorption of solar energy. Roberts, M.L.; Sharpe, M.H.; Krupnick, A.C. US Patent 4,104,134. 1 Aug 1978. Filed date 31 Aug 1977. 7p.

A panel is described for selectively absorbing solar energy comprising an aluminum substrate. A zinc layer was covered by a layer of nickel and an outer layer of solar energy absorbing nickel oxide or a copper substrate with a nickel layer. A layer of solar energy absorbing nickel oxide distal from the copper substrate was included. A method for making these panels is disclosed.

44652 New solar energy applications for glass. Deminet, C. (Boeing Aerospace Co., Seattle, WA). pp 74-83 of Twenty-second symposium on the art of glassblowing. Wilmington, DE; American Scientific Glassblowers Society (1978).

From 22. American Scientific Glassblowers symposium; Boston, MA, USA (19 Jun 1977).

Various applications of glass in the solar energy industry are discussed. A solar collector composed of a glass envelope that uses a black liquid absorber is described. The principle of heat absorbing glass is discussed; and its uses in venetian blind air collectors, transparent collectors for use in skylights, Trombe walls, and greenhouses are described. (WHK)

HEAT STORAGE

REFER ALSO TO CITATION(S) 44569

44653 (COO—4546-2) **Measurement of ^{222}Rn build-up in solar heated buildings and calculation of radiation doses. Final report of innovative research program subtask, December 1977—September 1978.** Johnson, J.E.; Olson, H.G. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 7p. Dep. NTIS, PC A02/MF A01.

The objectives of this project were twofold: (1) to compare the relative random concentrations within solar heated buildings using rock heat storage systems with radon levels found in non-solar buildings; and (2) to compare the radium concentration of various sources of granite rock used in solar heat storage systems. If radon concentrations in such solar heated houses are high, then selection of granite rock with low radium concentrations may be necessary.

44654 (COO—4546-3) **Trans-seasonal storage of solar energy. Final report of innovative research program subtask, December 1977—September 1978.** Kemper, W.D.; Walker, W.R. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 27p. Dep. NTIS, PC A03/MF A01.

The four major objectives of this project are listed: (1) to evaluate the efficiencies and economics of long term storage of solar energy as low temperature heat in shallow underground reservoirs constructed using in situ soil materials; (2) to review and develop simulation models for predicting the movement of water and heat in response to temperature and capillary pressure gradients in partially saturated porous media; (3) to simulate conditions which might predict the rate and extent to which dry insulating blankets of soil form around hot buried reservoirs. Also, to simulate the effect of confining barriers which restrict vapor and liquid flow of water; and (4) to evaluate the thermal conductivities of low cost and in situ materials which may be used in the construction of underground heat reservoirs and to develop methods of optimizing the thermal conductivities of these materials so that they can be used as thermal insulators and conductors.

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

USA

44655 (PB—286855) **Hawaii Geothermal Project. Engineering program. Quarterly report No. 2.** Augustus, J.; Chai, H.C.; Chen, B.; Cheng, P.; Chou, J. (Hawaii Univ., Honolulu (USA). Hawaii Geothermal Project). 1 Dec 1973. 86p. NTIS PC A05/MF A01.

The objectives of the Engineering Program are: (1) applied research in problem areas related to the extraction of energy from geothermal resources; and (2) planning, design, and specification of a research-oriented, environmentally-acceptable geothermal power plant. Work is progressing on the following four tasks: well test analysis; Ghyben-Herzberg lens dynamics; heat exchanger and binary-fluid cycle design; optimal hot brine plant design. This report summarizes the timetable for each task, the progress made to date, and the future work planned. Computer programs are supplied for Rankine cycle analysis and heat exchanger analysis.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

44656 (LBL—8515) **Studies of flow problems with the simulator SHAFT78.** Pruess, K.; Schroeder, R.C.; Zerzan, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 18p. (CONF-781222—3). Dep. NTIS, PC A02/MF A01.

From 4. workshop on geothermal reservoir engineering; Stanford, CA, USA (13 Dec 1978).

The main distinctive feature of SHAFT78 is that it uses an integrated finite difference method (IFD). Finite difference equations that are obtained by integrating the basic partial differential equations for mass and energy flow over discrete surface and volume elements are solved. This method is as easily applicable to irregular geometries of actual reservoirs as it is to idealized, regular geometries; yet the relative simplicity of the finite difference method is retained in the theory and algorithms. A brief review is given of the basic concepts associated with SHAFT78 and the IFD approach, and to present comparisons of SHAFT78 calculations with some analytical solutions. The comparisons include both single-phase and two-phase water problems and demonstrate the accuracy and calculational stability of the algorithm.

USA

REFER ALSO TO CITATION(S) 44679, 44688

44657 (DOE/ET/27129—T1) **Geological, geophysical and engineering investigation to evaluate the potential of the geothermal—geopressured reservoirs in Section 30, T15S-R17E, LaFourche Parish, Louisiana. Final report.** Eaton, B.A. (Eaton Industries of Houston, Inc., TX (USA)). Apr 1979. Contract AC08-79ET27129. 55p. Dep. NTIS, PC A04/MF A01.

The potential for drilling a well and encountering a geopressure section capable of yielding large quantites of fluids for a two-year flow test is explored. Tabulations, geologic cross sections, geologic maps, and drilling recommendations are included. Interpretations of seismic data and well information are included with geologic cross sections through the recommended drill site area showing fault locations, reservoir sands, and other pertinent facts concerning the well site subsurface structure. (MHR)

44658 (PB—284341) **Digital model of ground-water flow in the Piceance Basin, Rio Blanco and Garfield counties, Colorado. Final report.** Weeks, J.B. (Geological Survey, Lakewood, CO (USA). Water Resources Div.). Jun 1978. 115p. NTIS PC A06/MF A01.

The digital model used to simulate ground-water flow in the aquifer system in the basin drained by Piceance and Yellow Creeks in northwestern Colorado is described in detail. The model is quasi three-dimensional in that it simulates ground-water flow in a multia-

quifer system by assuming horizontal flow in the aquifers and vertical flow through the confining layers separating the aquifers. The model uses the iterative alternating-direction implicit procedure to solve the finite-difference flow equations. The digital model is documented by a program listing and flow charts. Data used in the model and sample output are presented to document the simulation of steady-state flow in the aquifer system. The variables used in the computer program and program options are discussed in detail.

NON-USA

44659 Hydrothermally altered rocks found in exploration borehole SA-1, Satsunan area. Kinbara, K., Ohkubo, T. *Ganseki Kobutsu Kosho Gakkaishi;* 73: No. 5, 125-136(May 1978). (In Japanese).

In 1974, exploration borehole SA-1 was sunk to a depth of 500 m in the Satsunan geothermal area of southern Kagoshima. The bottom-hole temperature was in excess of 240°C, and the fluid encountered was of the Na-Ca-Cl type (known as coastal thermal water'), which is derived from seawater. the rock samples from the bore had undergone severe hydrothermal alteration, characterized by the presence of chloritic clay minerals. By interaction of the thermal water and rock, chlorite is formed from volcanic glass and mafic minerals, passing through stages of Al-montmorillonite, (Mg, Fe-saponite), and a stratified chlorite-montmorillonite (saponite) assemblage. A stratified assemblage of sericite and montmorillonite was found just above the point at which drilling mud was lost. Gypsum was found throughout the core. Mordenite and clinoptilolite were found in the upper part, and wairakite in the lower part. Zeolites such as laumontite could not be found in the central part of the core. It is believed that all alteration minerals in the core were formed by rock/water interactions typical of present physicochemical conditions.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 44691

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 44657, 45476, 45488

44660 (LA—7804-MS) Aquarius Mountain area, Arizona: a possible HDR prospect. West, F.G.; Laughlin, A.W. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

Exploration for Hot Dry Rock (HDR) requires the ability to delineate areas of thermal enhancement. It is likely that some of these areas will exhibit various sorts of anomalous conditions such as seismic transmission delays, low seismic velocities, high attenuation of seismic waves, high electrical conducivity in the crust, and a relatively shallow depth to Curie point of magnetization. The Aquarius Mountain area of northwest Arizona exhibits all of these anomalies. The area is also a regional Bouguer gravity low, which may indicate the presence of high silica type rocks that often have high rates of radioactive heat generation. The one deficiency of the area as a HDR prospect is the lack of a thermal insulating blanket.

44661 Microseisms in geothermal exploration: studies in Grass Valley, Nevada. Liaw, A.L. (Arco Oil and Gas Co., Dallas, TX); McEvilly, T.V. *Geophysics;* 44: No. 6, 1097-1115(Jun 1979).

Frequency(f)-wavenumber(k) spectra of seismic noise in the bands $1 \leqq f \leqq 10$ Hz in frequency and vertical bar k vertical bar $\leqq$ 35.7 cycles/km in wavenumber, measured at several places in Grass Valley, Nevada, exhibit numerous features which can be correlated with variations in surface geology and sources associated with hot spring activity. Exploration techniques or geothermal reservoirs, based upon the spatial distribution of the amplitude and frequency characteristics of short-period seismic noise, are applied and evaluated in a field program at this potential geothermal area. A detailed investigation of the spatial and temporal characteristics of the noise field was made to guide subsequent data acquisition and processing. Contour maps of normalized noise level derived from judiciously sampled data are dominated by the hot spring noise source and the generally high noise levels outlining the regions of thick alluvium. Major faults are evident when they produce a shallow lateral contrast in rock properties. Conventional seismic noise mapping techniques cannot differentiate noise anomalies due to buried seismic sources from those due to shallow geologic effects. The noise radiating from a deep reservoir ought to be evident as body waves of high-phase velocity with time-invariant source azimuth. A small two-dimensional (2-D) array was placed at 16 locations in the region to map propagation parameters. The f—k spectra reveal shallow local sources, but no evidence for a significant body wave component in the noise field was found.

44662 Role of borehole geophysics in defining the physical characteristics of the Raft River geothermal reservoir, Idaho. Keys, W.S.; Sullivan, J.K. (U.S. Geological Survey, Denver, CO). *Geophysics;* 44: No. 6, 1116-1141(Jun 1979).

Numerous geophysical logs have been made in three deep wells and in several intermediate depth core holes in the Raft River geothermal reservoir, Idaho. Laboratory analyses of cores from the intermediate depth holes were used to provide a qualitative and quantitative basis for a detailed interpretation of logs from the shallow part of the reservoir. A less detailed interpretation of logs from the deeper part of the reservoir is based on much less corroborative evidence. Extensive use was made of computer plotting techniques to arrive at some interpretations. Both the stratigraphic correlation utilizing a full suite of logs and the attitude of bedding calculated from acoustic televiewer logs indicate gentle dips throughout most of the reservoir with some local flexures. Televiewer logs permitted the location and orientation of numerous fractures and several features that may be faults. Temperature and flowmeter logs provide evidence that these fractures and faults are conduits that conduct hot water to the wells. One of the intermediate depth core holes penetrated a hydrothermally altered zone that includes several fractures producing hot water. This altered production zone could be distinguished by several logs. Borehole gamma spectrometry can be used to identify anomalous concentration of uranium, thorium, and potassium which are probably due to transportation by hydrothermal solutions. Computer crossplotting was used as an aid to the identification of such rock types as quartzite, quartz monzonite, and biotite schist in the deeper wells. Alteration of biotite schist to chlorite schist was also recognizable on these logs using computer-based analysis.

44663 Self-potential method in geothermal exploration. Corwin, R.F. (Univ. of California, Berkeley); Hoover, D.B. *Geophysics;* 44: No. 2, 226-245(Feb 1979).

Laboratory measurements and field data indicate that self-potential anomalies comparable to those observed in many areas of geothermal activity may be generated by thermoelectric or electrokinetic coupling processes. A study using an analytical technique based on concepts of irreversible thermodynamics indicates that, for a simple spherical source model, potentials generated by electrokinetic coupling may be of greater amplitude that those developed by thermoelectric coupling. Before more quantitative interpretations of potentials generated by geothermal activity can be made, analytical solutions for more realistic geometries must be developed, and values of in-situ coupling coefficients must be obtained. If the measuring electrodes are not watered, and if telluric currents and changes in electrode polarization are monitored and corrections made for their effects, most self-potential measurements are reproducible within about +-5 mV. Reproducible short-wavelength geologic noise of as much as +-10 mV, primarily caused by variation in soil properties, is common in arid areas, with lower values in areas of uniform, moist soil. Because self-potential variations may be produced by conductive mineral deposits, stray currents from cultural activity, and changes in geologic or geochemical conditions, self-potential data must be analyzed carefully before a geothermal origin is assigned to observed anomalies. Self-potential surveys conducted in a variety of geothermal areas show anomalies ranging from about 50 mV to over 2 V in amplitude over distances of about 100 m to 10 km. The polarity and waveform of the observed anomalies vary, with positive, negative, bipolar, and multipolar anomalies having been reported from different areas. Steep potential gradients often are seen over faults which are thought to act as conduits for thermal fluids. In some areas, anomalies several kilometers wide correlate with regions of known elevated thermal gradient or heat flow.

44664 Seismological investigations at The Geysers geothermal field. Majer, E.L.; McEvilly, T.V. (Univ. of California, Berkeley). *Geophysics;* 44: No. 2, 246-269(Feb 1979).

Two short (4 and 6 day) recording periods at The Geysers geothermal field provided useful data on two large refraction explosions and numerous microearthquakes. The vapor-dominated reservoir appears to be characterized by regionally anomalous high P- and S-wave velocities and low attenuation, but the anomaly seems to decrease, possibly reversing, with depth. Microearthquakes occur in a diffuse pattern, with no indication of dominant throughgoing faults and an absence of activity in the main production zone. Mechanisms are generally consistent with northeast-southwest compression. Occurrence rates indicate a slightly high incidence of smaller magnitude shocks. It is possible that the microearthquake activity is related to an expanding steam zone. While the present anomalies appear to delineate the reservoir, it is not certain that they would have been detectable during exploration prior to large-scale exploitation of the field.

44665 Telemetering method and apparatus for geothermal energy. Ochiai, T. (to Toshiro Ochiai). Japanese Patent 1978-93,101. 15 Aug 1978. 4p. (In Japanese).

A telemetering method was patented in which an infrared detector and a thermal radiation detector are fitted to a vehicle (helicopter, car, etc.) and directed downward. The detectors can be used to determine infrared and thermal radiation levels in geothermal areas or suspected geothermal areas while avoiding interference by sunlight.

44666 Investigation of hot springs in Kamifurano-cho, Kamikawa Sub-prefecture, Central Hokkaido. Hirota, T., Yokoyama, E., Wake, T., Sakuma, T. *Hokkaidoritsu Chika Shigen Chosasho;* No. 50, 57-70(Mar 1978). (In Japanese).

Geophysical, geochemical, and geological investigations were made of the hot springs area located on the western side of the active volcano Tokachi-dake, to determine geologic structure and to examine the origin of high temperature springs. The Fukiage, Bengara, and Okine hot springs are located in low resistivity areas characterized by high underground temperatures. Geochemical studies indicate that fumarolic fluids are high temperature and strongly acid while thermal water on the mountainside is strongly acid but low temperature. The geologic survey indicates that thermal waters infiltrate through porous parts and cracks within agglomerate, boundaries between agglomerate and lava, and fissure zones. The waters are contaminated by colder ground water and minerals. The underground temperature is estimated at 50°C at 200 m. Nine figures and two tables are provided.

44667 The 1976 steam explosion of the Kusatsu-Shirane Volcano and the outline of the joint geophysical observation. Shimozuru, D. (Earthquake Research Institute, Japan), Gyoda, N., Koyama, E., Miyazaki, M., Sawada, M., Osada, N., Hagiwara, M., Takeda, T. *Tokyo Daigaku Jishin Kenkyusho Iho;* 53: 569-580(1978). (In Japanese).

The Kusatsu-shirane Volcano, located 30 km north of the Asama Volcano erupted steam in 1976 at the NE corner of the Mizugama crater. The newly opened crater is elliptical in shape with axes of 42 m and 60 m and a depth of 12 m immediately after the eruption. No juvenile substance was thrown out. At the end of November 1975, a photographer, S. Miyazaki, visited the volcano and found a circular patch of melted ice on the crater lake three months before the eruption. The melted part was approximately 15 m in diameter and coincided with the site of the newly opened crater. The Earthquake Research Institute organized joint geophysical observations including seismic, geomagnetic, geothermal, geodetic and gravimetric surveys. Temporary seismic observation and repeated surveys of total geomagnetic intensity indicated that the eruptive activity was over and no indications of the heat supply from beneath the Kusatsu-shirane Volcano were found. In spite of such degenerated volcanic activity, increased temperature was observed inside the crater which seemed to be contradictory. After the formation of the new crater, a large amount of cold water and melted snow were drained into the new vent. Therefore, at the time of the first infra-red survey in April, the temperature beneath Kusatsu-shirane was expected to drop for a while. This may be the reason why the termperature has markedly increased in spite of the declining volcanic activity. The results of the joint observations for each discipline are described in detail. Eleven figures, three tables, and eight references are provided.

44668 Geothermal survey of the Kusatsu-Shirane Volcano. Kagiyama, T. (Earthquake Research Institute, Japan), Koyama, E., Gyoda, N., Shimozuru, D. *Tokyo Daigaku Jishin Kenkyusho Iho;* 53: 581-605(1978). (In Japanese).

The volcano Kusatsu-shirane located 30 km north of the volcano Asama had a steam eruption at the end of Februuary 1976 in the NE part of the Mizugama crater. A photograph taken by a visitor three months before the eruption showed abnormal geothermal activity where the explosion occurred. But, no clear precursory vcolcanic earthquakes occurred. Geothermal surveys were made to predict future volcanic activity. The surveys were carried out by infrared ground-based scanner and Canon Thermo-Camera CT-4B for the surface temperature distribution and thermistor probes for temperature distribution at 1 m depth. According to the infrared survey, a significant temperature decrease inside the newly opened crater and a significant increase at the NE part of the inner wall of Mizugama were detected. The decrease in temperature of the vent inside the newly opened crater was due to blockage by muddy lake sediment. The reason for the increase in temperature at the NE inner wall of Mizugama is not clear, however, it may indicate future geothermal activity. The 1 m depth temperature distribution at 151 spots showed that geothermal activity was high in the area north and east of Yu-gama which suggests a site of future volcanic activity. Twenty-one figures, nine tables, and 10 references are provided.

GEOCHEMICAL TECHNIQUES AND SURVEYS

44669 Geothermal resources at Rausu hot spring in Rausu-cho, Menashi Province, Hokkaido. Wake, T., Matsunami, E., Yokoyama, H., Kawamori, H., Fugimoto, K., Sakuma, T., Futamase, K. *Hokkaidoritsu Chika Shigen Chosasho;* No. 50, 35-55(Mar 1978). (In Japanese).

Geothermal resources were investigated at Rausu hot springs in 1976 by drilling geothermal test wells to 191 m. Thermal water with a temperature above 90°C is characterized by high amounts of Na, Cl, TSM, SO_4, SiO_2, and H_2S, and low amounts of Ca, Mg, Mn, and total Fe. The spring water at Rausu is characterized by NaCl. At a depth of 81-91 m, underground temperature rose to over 140°C. The geologic formation was hornblende porphyry at this depth. Nearby fissure zones run NE-SW and NW-SE, and thermal water and alteration zones are located around Yunosawa, Moto-yunosawa, and Rausu-gawa. Eighteen figures, eight tables, and four references are provided.

44670 Remote sensing measurements of sulfur dioxide emissions from the volcano Asama. Ohta, K.(Kyushu University, Japan), Kagiyama, T., Matsuo, N. *Tokyo Daigaku Jishin Kenkyusho Iho;* 53: 533-542(1978). (In Japanese).

The quantity of the SO_2 emission from the volcano Asama was remotely measured at the eastern foot using Barringer's correlation spectrometer (COSPEC IV-B) from 16 to 20, September 1977. Two different methods were adopted for the measurements: the panning method, turning the side-viewing COSPEC on the volcanic plume just above the crater rim and sweeping almost horizontally, the traverse method, traverse below the volcanic smoke flow with the upward-viewing COSPEC mounted on a car. The SO_2 emission averaged 218 metric tons/day, ranging from 84 to 375 tons. The rate of emission fluctuates, but the daily average shows variations similar to the frequency of B-type volcanic earthquakes. This evidence implies that the mechanism of shallow volcanic earthquakes are the consequences of increasing pore pressure at the shallow part of the summit region during the degassing process. Comparing the present result with the previous data, the SO_2 emission and the monthly frequency of B-type earthquakes in 1972 were almost the same as 1977. But, while the SO_2 emission in 1974, just after the eruption in 1973, was as much as four times that of 1977, the seismic activity was markedly low. This is probably because the volcanic gas was able to pass through the conduit easily due to the eruption in 1973 and hence the port pressure could not increase. The quantitative and qualitative monitoring of volcanic smoke may be means of predicting volcanic eruptions. Seven figures, three tables, and five references are provided.

44671 Distribution of underground-water and soil-air radon concentrations around the Asama volcano- observations in 1977. Sato, K. (Earthquake Research Institute, Japan), Sato, J., Takashashi, H., Hosoya, Y. *Tokyo Daigaku Jishin Kenkyusho Iho;* 53: 543-549(1978). (In Japanese).

Radon concentration in underground and hot-spring waters around Mt Asama is of the order of 10 to the -11 power Ci/l, varying up to 6 x 10 to the -11 power Ci/l. The spatial distribution of soil-air radon obtained with the α-track film (nitrocellulose) technique is also uneven but shows a pattern somewhat different from that of the underground-water radon. Both the underground-water and soil-air radon concentrations appear to show no positive correlation with the distribution of radioactivity in volcanic rocks occurring in the field. Three figures, two tables, and five references are provided.

44672 Variations in chemical species in the groundwater around the Asama volcano- relation to the explosive activity of 1973. Takahashi, H. (Earthquake Research Institute, Japan), Hosoya, Y. *Tokyo Daigaku Jishin Kenkyusho Iho;* 53: 551-568(1978). (In Japanese).

Geochemical surveys of groundwater have been carried out during March 1972-May 1973 and August 1977-March 1978, around the Asama Volcano in order to collect basic information regarding the influence of volcanic activity on the physical and chemical properties of groundwater. Atmospheric temperature, water temperature, pH, RpH and electric conductivity were measured and chemical components, such as Na, K, Ca, Mg, Fe(II), HCO_3 and Cl were analyzed for four springs and four boreholes. At almost all wells, the physico-chemical characteristics of the water were found to be stable throughout the year, while a remarkable seasonal variation was observed in the acidic water at Jigokundani. The temperature, pH and electric conductivity of spring water, except the acidic water at Jigokundani were within the range of 7.5-13.2°C, 4.9-5.9, and 250-820 μohm and those of borehole one were 15.3-42.9°C, 6.7-7.6 and 500-620 μohm, respectively. The 1973 eruption of the Asama Volcano began on February 1 and continued with 15 major explosive events until April 26. At some observation points situated southeast of the crater, the concentration of dissolved components varied before and after the present activity, but no remarkable changes were observed during the quiet period, ie, August 1977-March, 1978. In addition to surveys at regular intervals, continuous measurements of the water temperature and electric conductivity are now planned at a few wells, which might play some role ... monitoring volcanic activity. Eleven figures, three tables, and 16 references are provided.

44673 Investigations of hot springs in the Uchikamado area of Beppu City. Yoshikawa, K. (Kyoto University, Japan), Yusa, Y., Kitaoka, G, Noda, T. *Oita-ken Onsen Chosa Kenkyu-kai Hokoku;* No. 28, 1-10(Mar 1977). (In Japanese).

The chemical composition of hot springs in the Uchikamado area, Beppu City, was investigated. The springs were categorized into the following four groups: Group A includes the area from Yumizu-Furuichi to and including Sainenji, Group B includes the Kamadomon jinja area and neighboring hills, Group C includes the area from Noda to the National Hospital along the Niikawa River, and Group D includes the lowlands near the area of Hamada. The A and B springs have a higher HCO_3/Cl ratio than the Kamekawa hot springs and a low SO_4/Cl ratio similar to springs in and around Kaionji, south of Beppu. High temperature springs are located below the B area. Hot springs in Group C have neutralized H_2SO_4 water of the Shibaishi-Noda system. Water in the D area is a mixture of B and C water. In general, the hot spring water is nearly neutral and has a higher Na/Cl ratio than that of the Kamekawa hot springs. Ten figures, two tables, and seven references are provided.

44674 Invasion of seawater into the hot spring area south of Beppu. Yoshikawa, K. (Kyoto University, Japan), Kitaoka, G. *Oita-ken Onsen Chosa Kenkyu-kai Hokoku;* No. 28, 17-25(Mar 1977). (In Japanese).

The chemical content of hot springs in the southern Beppu area was determined in an attempt to assess the invasion of seawater. Approximately 30% of the 92 springs were sampled during July 20 to August 6, 1976. The pH and HCO_3 concentraton were determined by conventional methods, and the Cl concentration was determined by Mohr's method. Cationic ion concentraton was determined by atomic absorption spectrophotometry. All of the spring water in this area is neutral or nearly neutral. The average temperature is 49.5°C, and the maximum temperature is 63.5°C. The springs usually either contain < 0.2 g/l of Cl or > 0.4 g/l. Hot spring water with a Cl concentration greater than 0.5 g/l probably indicates infiltration by seawater. The seawater-invaded area expanded during the 1950's to all of the landfill area, and in 1963 reached the former Beppu Port. Now it is proceeding to Kusunoki-cho. Six figures, three tables, and 11 references are provided.

EXPLORATORY DRILLING AND WELL LOGGING

44675 Test drillings for geothermal and hot springs in the upstream of the Yanbetappu River of the Mt. Daisetsu. Uchida, Y., Takebayashi, I., Suzuki, T., Kawamori, H. *Hokkaidoritsu Chika Shigen Chosasho;* No. 50, 71-79(Mar 1978). (In Japanese).

Two wells were drilled near geothermal indicators (fumaroles and mud pots) in the Daisetsu volcanic area along the upper Yanbetappu River. The Kogen Onsen well produced 8 t/h of 130°C water at a depth of 255 m. The following conclusions were reached concerning drilling technology: When drilling a steam well, it is important to close fissures not at the finished depth, BH drilling mud is effective under high temperatures, Exhalation should be prevented by cooling and by increasing the specific density of the drilling mud. Three figures, nine tables, five maps, and eight references are provided.

LEGAL AND INSTITUTIONAL ASPECTS

44676 (UCRL—13955(Vol.2)) **Socioeconomics.** Smith, T.C.; Sharda, B.D. (Utah Univ., Salt Lake City (USA)). Sep 1978. Contract W-7405-ENG-48. 158p. Dep. NTIS, PC A08/MF A01.

Geothermal energy development in Beaver County, Utah, in the Roosevelt Hot Springs, Cove Fort/Sulphurdale, and Thermo KGRAs will result in socio-economic and cultural impacts. These impacts are examined and an overview is presented of present data, data gaps, and recommended studies. A model is presented which is expected to predict socio-economic and cultural impacts of geothermal energy development more accurately. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

44677 An economic analysis of the hot dry rock geothermal energy resource. Cummings, R.G. (University of New Mexico, USA), Nunn, S.C., McFarland, J.W. *Resour. Energy;* **1**: No. 2, 109-123(Oct 1978).

Still in its early stages of development, hot dry rock (HDR) geothermal technology may provide the means to tap the enormous stock of energy stored as heat in the earth's crust. By drilling a well deep into impermeable granite and creating a thin fracture over which water is passed and heated, geothermal power can be generated where natural water deposits do not occur. The first such well is in operation at the Los Alamos Scientific Laboratory. The research in progress there should shed light on the many technical uncertainities surrounding the process. Given current assumptions on costs and physical characteritiscs of HDR reservoirs with thermal stress cracking, the potential economic feasibility of the process for generation of electric power is investigated. Preliminary results reported here indicate that under these optimistic physical assumptions, the resource may generate electricity at competitive prices at those sites where the geothermal gradient (the increase in temperature to depth) exceeds 30 C/km-a condition which characterizes much of the Western three-fourths of the U.S.

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 44676

44678 (PB—288128) **Impact prediction manual for geothermal development.** (Woodward-Clyde Consultants, San Francisco, CA (USA)). Jun 1978. Contract DI-14-16-0008-2132. 163p. NTIS PC A08/MF A01.

The manual presents techniques for predicting probable effects of geothermal development on fish and wildlife resources in the Western United States. It consists of a two part text. Part one deals with the concepts underlying the manual; part two discusses chains of cause-and-effect and describes qualitative and quantitative analysis of impacts. Appendices include an annotated bibliography; an example of a data collection program; a listing of endangered, threatened, and protected flora and fauna; and a supplement to erosion analysis techniques outlined in the manual.

44679 (UCRL—13955(Vol.1)) **Environmental overview report on Utah geothermal resource areas: Roosevelt Hot Springs, Cove Fort-Sulphurdale Thermo Hot Springs-Lund KGRAs.** White, K.L.; Hill, A.C.; Ursenbach, W.O. (eds.). (Utah Univ., Salt Lake City (USA). Environmental Studies Lab.). Sep 1978. Contract W-7405-ENG-48. 188p. Dep. NTIS, PC A09/MF A01.

Environmental concerns from potential development at Roosevelt Hot Srings, Cove Fort/Sulphurdale, and Thermo/Lund KGRAs have been identified. The following topics are covered: a summary of environmental issues, air quality, noise, water quality and hydrology, geology, and ecosystems. (MHR)

44680 (UCRL—81572) **Case study of a Salton Sea geothermal brine disposal well.** Morse, J.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1978. Contract W-7405-ENG-48. 5p. (CONF-7810170—2). Dep. NTIS, PC A02/MF A01.

From 2. international well-testing symposium; Berkeley, CA, USA (25 Oct 1978).

An injection pressure history was compiled for the Magmammax number 3 (MM3) well located in the Salton Sea Geothermal Field. MM3 is used for the disposal of spent brine from the SDG & E Geothermal Loop Experimental Facility (GLEF). During two years of operation from 5/3/76 to 4/13/78, 2.1 x 10^8 gallons of cooled hypersaline (210,000 ppM TDS) brine was injected into the well. The well was operated intermittently over the two-year period with a cumulative operating time of 7886 hours. The operating time is composed of 33 flow periods with four periods greater than 700 hours and one in excess of 1000 hours. The wellhead injection pressure required for an average flow rate of 443 GPM varied from 100 to 500 PS during the two years of operation.

GEOTHERMAL POWER PLANTS

44681 Geothermal Energy. Nakamura, H. (Japan Metals and Chemicals Co., Ltd.). *Genshiryoku Kogyo;* **24**: No. 5, 14-17(1978). (In Japanese).

A nationwide basic investigation of geothermal resources was begun in Japan shortly before the oil crisis of 1973. Thirty areas have been surveyed thus far and secondary investigations of these areas have begun. Before the oil crisis, there were four geothermal power stations in operation: Matsukawa (22 MW), Onuma (10 MW), Onikobe (25 MW), and Otake (11 MW). Since then, Hatchobaru (50 MW) and Kakkonda (50 MW) have been completed, and the total generating capacity at present is 168 MW. Nigorigawa in Hokkaido is the only recently explored geothermal field, and a 50 MW plant is planned. The cost of geothermal power generation is presently about the same as oil-fired steam power generation. In the future, geothermal energy sould have the economic advantage as government support increases. Of the 200 geothermal fields in Japan, 80% are in the national parks, which causes environmental management problems. In the future, Japan should produce 2000 MW of geothermal power. One figure and one table are provided.

DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 44655

POWER PLANT SYSTEMS AND COMPONENTS

44682 Geothermal energy utilization device. Mori. J. (to Jotaro Mori). Japanese Patent 1978-40,976. 30 Oct 1978. 2p. (In Japanese).

A geothermal utilization device was patented which consists of an air-blowing pipe, an air blower, a hot-air lead pipe and an outlet device, and a heat insulating device. Air is blown into a geothermal reservoir through the air pipe by the air blower. The heated air is then removed through the lead pipe which is insulated to prevent heat loss. Hot air is continuously discharged. The system uses less electricity than existing systems, and the hot air can be utilized to turn a power generator.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 44675

44683 (DOE/ET/28451—7) **Evaluation and design of downhole heat exchangers for direct application. Final report, July 1, 1977—November 15, 1978.** Culver, G.G.; Reistad, G.M. (Oregon Inst. of Tech., Klamath Falls (USA); Oregon State Univ., Corvallis (USA)). Dec 1978. Contract EY-76-S-06-2429. 120p. Dep. NTIS, PC A06/MF A01.

An experimental and analytical research program to evaluate and improve the design of downhole heat exchangers (DHEs) for direct applications of geothermal energy is reported. During the past year, significant progress has been achieved in: (i) characterizing flows in wells with perforated casings and DHEs installed, (ii) determination of energy extraction rates for short multitube DHEs in wells, (iii) utilization of information obtained during the first year's work and to improve and substantiate models of heat transfer within the well including the mixing of aquifer and well waters, (iv) development of new flow measuring techniques, and (v) economic analysis comparisons of DHEs and surface heat exchanger systems.

44684 (NVO—203) **Coastal Plains geothermal drilling and testing plan. Crisfield Airport No. 1 well, Crisfield, Maryland.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office; Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1979. 85p. Dep. NTIS, PC A05/MF A01.

Using basement depth data, available petrologic and stratigraphic information, estimates of radioactivity, and available existing well data, some 50 sites from New Jersey to Georgia were selected for the drilling of 1,000- to 1,900-foot-deep heat flow measurement holes. Based upon temperature gradients and thermal conductivities from these holes and criteria established for an ideal reservoir for commercial production, a potential area for a deep test well was to be selected. As a result of heat flow measurements in the first 50 shallow holes, projections of temperature at interpreted basement depths were made. These results indicated four prospective areas in which to drill a deep geothermal test well. Additional assessment studies conducted by the Applied Physics Laboratory at Johns Hopkins University to determine an optimum area based on socio-economic criteria indicated that an area in the Delmarva Peninsula has potential for future commercial development. This combination of criteria led to the selection of Crisfield, Maryland, as the site for the deep geothermal test well. The following are outlined: generalized site activities, occupational health and safety, drilling operations, aquifer testing program, plugging and abandonment, environmental assessment and monitoring program, permits, and program management.

44685 (SAND—78-1409) **Portable high-temperature, high-pressure viscometer development.** Reineke, R.C. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

A field instrument for measuring the rheological characteristics of drilling mud at temperatures up to 500°F (260°C) and pressures of 12,500 psi has been developed. This instrument allows a direct determination of fluid viscosity under simulated downhole conditions. The instrument is comprised of a rotational viscometer packaged in a high-temperature, high-pressure vessel. Heat is applied by use of electric resistance heaters, and pressure is applied by a hand operated hydraulic pump. The unit is completely portable and weighs approximately 60 pounds. The instrument has been utilized to measure the properties of both water-based and oil-based drilling fluids to temperatures of 260°C. The design and construction of the instrument is described and the results of measurements of six different drilling fluid formulations are presented. These test results show that in general, water-based samples exhibit a marked increase in viscosity with increasing temperature, but little effect is observed with increasing pressures. In oil-based muds the thinning effect caused by increasing temperature is partially compensated for by the thickening effect of increasing pressure.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 45152

44686 (DOE/TIC—10145) **U.S. Energy Research and Development Administration Geothermal Component Test Facility, East Mesa, Imperial Valley, California.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1976. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

The East Mesa Geothermal Test Facility is described and the history of the test site is reviewed briefly. The experimental programs planned are mentioned. (MHR)

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

44687 (ORNL/PPA—79/2) **Geopressure energy resource evaluation.** Samuels, G. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 79p. Dep. NTIS, PC A05/MF A01.

The geopressured aquifers that extend along the northern Gulf of Mexico are a large, perhaps the largest, potential source of geothermal energy and natural gas in the United States. Because of the high cost of completing wells into these formations and their relatively low temperatures (200 to 400°F), the utillzation of the geothermal energy will be highly dependent on, and of secondary importance to, the value of the methane. The economics of extracting either the geothermal energy or natural gas from these aquifers does not look promising. The combined requirements of high well flow rates (40,000 bbl/day), long life (20 years), and the necessity for close well spacing to minimize the cost of the collection system may be incompatible with the actual characteristics of the reservoirs. These factors place such stringent requirements on the reservoir size, permeability, and compressibility, or specific storage coefficient, that the number of promising production areas may be severely limited.

44688 (PB—286854) **Hawaii Geothermal Project. Phase III - well testing and analysis. Quarterly progress report No. 3, 1 April-30 June 1977.** Shupe, J.W.; Helsley, C.E.; Yuen, P.C. (Hawaii Univ., Honolulu (USA). Hawaii Geothermal Project). 1 Jul 1977. 76p. NTIS PC A05/MF A01.

Brief reports are presented for the following geoscience tasks: seismic studies, geochemistry, hydrology, and physical properties of rocks. Also included is a report on numerical modeling, which outlines the current status of the study on free convection in a multilayer geothermal reservoir with application to the Kapoho Geothermal Field. Six cases are under review to determine the effects of different Rayleigh numbers and length to height ratios on reservoir characteristics. Much of the report is devoted to the well testing program and to the preliminary analysis and interpretation of data. A 1000-hour (42-day) flow test was completed on May 9, 1977. In reservoir engineering, a first cut is taken on establishing reasonable models for HGP-A and for the Kapoho Geothermal Reservoir. These include three pre-drilling speculative models of the drill site, as well as broader modelling of the reservoir associated with HGP-A. Estimates are also presented on the possible magnitude and lifetime of reservoirs in the Puma Rift zone. Although quite speculative, this preliminary analysis does establish the possibility of significant geothermal potential for the Big Island.

44689 The movement of reinjected thermal water in the Otake geothermal field. Yuhara, K. (Kyushu University, Japan), Akibayashi, S. *Nippon Kogyo Kaishi;* **94**: No. 1086, 509-514(1978). (In Japanese).

Pressures, flow rates and tracer arrival times were measured at injection and production wells in the Otake geothermal field. The obtained data were analyzed in order to estimate the pressure and transmissibility distribution in the geothermal reservoir. Substitution of the above mentioned information into the equation of motion of the fluid flow through porous media led to an equation with the transmissibilities and two components of fluid flow as unknown. The flow and transmissibility patterns in the Otake geothermal field could be estimated by solving this equation, using calculus of finite difference, with suitable boundary conditions. Nine figures, five tables, and ten references are provided.

44690 Durability of slag cement in hot spring water. Okada, K. (Seitetsu Kagaku Co., Ltd., Japan), Furukawa, R., Miyairi, H. *Semento Gijutsu Nenpo;* No. 31, 272-274(1977). (In Japanese).

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

44691 (LA—7807-HDR) **Hot dry rock geothermal energy development program. Annual report, fiscal year 1978.** Brown, M.C.; Duffield, R.B.; Siciliano, C.L.B.; Smith, M.C. (comps.). (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 132p. Dep. NTIS, PC A07/MF A01.

During this period, Run Segments 1-3 were completed in the prototype reservoir of the Phase I energy-extraction system at Fenton Hill, New Mexico. These tests yielded significant data on system flow parameters, water loss rates, geofluid chemistry, downhole flow impedance, operational constraints, mathematical modeling, technology and instrument capabilities, and environmental effects of operation. The technical results indicated that energy (thermal or electrical) from hot dry rock may be a feasible alternate energy source and prompted the Department of Energy to expand the project into a national Hot Dry Rock Geothermal Energy Development Program. To further prove the concept, plans were prepared for a Phase II system with a commercial-size reservoir that will demonstrate the production lifetime of such a system. This deeper, hotter reservoir will require improved and new instruments and technology, which are being developed at the Los Alamos Scientific Laboratory and also by industry and other institutions. To expedite development of this promising energy resource, communication and information exchange on a national and international basis were continued.

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 44683

WIND ENERGY

REFER ALSO TO CITATION(S) 44474

AVAILABILITY (CLIMATOLOGY)

44692 (JUL-Conf—27) **Seminar and status report on wind energy.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Nichtnukleare Energieforschung). 1978. 401p. (In German). (CONF-7810148—). Dep. NTIS (US Sales Only), PC A18/MF A01.

From Seminar and status report on wind energy; Julich, F.R. Germany (23 Oct 1978).

Papers are presented concerning meteorological considerations for wind turbines; small wind power plants; and large wind power plants.

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 44546

44693 (N—78-29583) **The 200-kilowatt wind turbine project.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jan 1978. 17p. NTIS PC A02/MF A01.

The three 200 kilowatt wind turbines described, compose the first of three separate systems. Proposed wind turbines of the two other systems, although similar in design, are larger in both physical size and rated power generation. The overall objective of the project is to obtain early operation and performance data while gaining initial experience in the operation of large, horizontal-axis wind turbines in typical utility environments. Several of the key issues addressed include the following: (1) impact of the variable power output (due to varying wind speeds) on the utility grid (2) compatibility with utility requirements (voltage and frequency control of generated power) (3) demonstration of unattended, fail-safe operation (4) reliability of the wind turbine system (5) required maintenance and (6) initial public reaction and acceptance.

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 44692, 44933

44694 (DOE/NASA/1059—79/2) **Large horizontal axis wind turbine development.** Robbins, W.H.; Thomas, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EG-77-A-29-1059. 16p. (NASA-TM—79174). Dep. NTIS, PC A02/MF A01.

One facet of the Federal Wind Energy Program,, Large Horizontal Axis Wind Turbine Development, is being managed by the NASA Lewis Research Center. First-generation-technology large wind turbines (Mod-OA and Mod-1) have been designed and are in operation at selected utility sites. Second-generation machines (Mod-2) are scheduled to begin operations on utility sites in 1980. These second-generation machines are estimated to generate electricity at less than 4 cents/kWh when manufactured at modest production rates. However, to make a significant energy impact, costs of 2 to 3 cents/kWh must be achieved. The federal program will continue to fund the development by industry of wind turbines which can meet the cost goals of 2 to 3 cents/kWh.

44695 (Juel-Spez—28) **Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung (PLE)). Jan 1979. 268p. Dep. NTIS (US Sales Only), PC A12/MF A01.

Separate abstracts are included for each of the papers presented concerning the aerodynamics, stability, and design aspects of large wind turbines.

44696 (Juel-Spez—28, pp 1-49) **Investigations of structural dynamics on the Gedser WTG and on new Danish wind turbines.** Lundsager, P.; Christensen, C.J. (Risoe National Lab., Denmark). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

A survey is given of activities on Risoe National Laboratory related to structural dynamics of large WTG's. Since only a few of the activities have yet been completed, the presentation is a review of status, preliminary conclusions and experience. The topics dealt with in the presentation are: analysis of prototype WTG rotors; analysis of the Gedser WTG rotor; and measurements on the Gedser WTG. Investigations being made of the power train oscillations in the Gedser WTG are dealt with in some detail.

44697 (Juel-Spez—28, pp 51-94) **Measurements of performance and structural response of the Danish 200 kW Gedser windmill.** Lundsager, P. (Risoe National Lab., Denmark); Askegaard, V.; Bjerregaard, E. Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Static and dynamic measurements being performed on the 20 year old Danish Gedser windmill as a part of the Danish government and utility sponsored wind power program are described. The design of the mill, which in several points differ essentially from most modern designs, is still of interest since the mill has been in operation during a 10 year period without major mechanical troubles. The main objectives of the measurements are the determination of the power curve, the structural response especially of the rotor and the power quality, but the instrumentation lay-out also aims at obtaining results which should be useful in the verification of models for windmill analysis.

44698 (Juel-Spez—28, pp 95-104) **Strategy for aeroelastic analysis of WECS .** Fabian, O. Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Within the finite element method, the rotor blades are usually modelled by beam elements belonging to a co-ordinate system co-rotating with the rotor hub. In the case of a flexible tower, however, this rotating system is both pitched and yawed. The inclusion of these additional motions in the vibration analysis constitutes a severe problem. The propositions presented concerns a purely inertial formulation of the vibration problem avoiding this difficulty.

44699 (Juel-Spez—28, pp 105-138) **Modes and frequencies of GROWIAN rotor blades.** Petersen, D. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Braunschweig). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Due to the known construction of GROWIAN rotor blades, modes and frequencies were calculated. The computer program used takes into account centrifugal force effect, the offsets of shear center, center of bending stiffnesses, and center of gravity. Furthermore, the effects of pre-loading and pre-twist are induced within the current version. Thus, modes and frequencies of a reference version could be calculated, and regions where the mathematical modelling was un-

certain due to a lack of information or difficulties of modelling are discussed.

44700 (Juel-Spez—28, pp 139-159) **Dynamics of wind turbine rotor blades.** Ludwig, D. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Based on the eigenanalysis of wind turbine rotor blades stability and response characteristics can be determined. The structure is modeled by finite beam elements, which are specially developed for rotating blades. The p-k method was used to determine the flutter stability. Finally, the problem of discrete gust loading is considered.

44701 (Juel-Spez—28, pp 161-179) **Aeroelastic modeling of the coupled wind turbine rotor/tower system.** Kiebling, F. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Vibration and aeroelastic stability analyses of wind turbines generally cannot neglect the interaction between rotor and tower. So at least finally an aeroelastic model of the complete system must be considered. The derivation of the corresponding equations of motion is described together with the more important parameters of the wind turbine system.

44702 (Juel-Spez—28, pp 181-196) **Dynamic design of a medium stiff wind energy tower.** Kovacs, I. (Leonhardt und Andrae, Stuttgart, Germany). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

As a rule, wind energy towers are designed for high eigenfrequencies, which can be obtained only through high stiffnesses. Against this, a design concept with only medium stiffnesses is presented. The first eigenfrequencies of the tower are designed to lie between the lower rotor frequency and the higher blade-passage frequency. Thereby all sensitive system resonances can be isolated. The frequency bands in which the eigenfrequencies of the tower cannot be excited are extremely narrow. Therefore the towers must be prepared for a supplementary tuning for cases if their actual eigenfrequencies deviate from the predetermined values. The cable-stayed masts as proposed have different advantages for wind energy towers. Among others, they are most suitable for the medium stiffness concept and their actual eigenfrequencies can be easily tuned afterwards.

44703 (Juel-Spez—28, pp 197-214) **Calculation of the natural frequencies of the braced GROWIAN tower with dead head mass.** Cuntze, R.; Zaun, J. (Maschinenfabrik Augsburg-Nuernberg, Germany). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

The natural frequencies of the braced GROWIAN steel and concrete tower were determined. In the calculation the main assumption to treat the machine house and the rotor as a dead mass was made. The FEM model consisted of the tower-bar element-structure and the rope-cable structures. All substructures were elastically bound to the soil. The prestressing of tower and cables was taken into account. The calculation procedure and the mechanical and numerical difficulties were discussed. Parametric investigations were undertaken to get an idea of the sensitivities of some main parameters. A comparison of the steel and the concrete tower natural frequency results are given at the end of the lecture.

44704 (Juel-Spez—28, pp 216-237) **Computer methods for structural weight optimization of fiber reinforced plastics.** Thor, S.E. (FFA, Stockholm, Sweden). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Some of FFA's computer programs for analysis and optimum design of fiber reinforced plastics are discussed. A general flow chart for analysis of fiber reinforced structures is presented.

44705 (Juel-Spez—28, pp 239-269) **Structural dynamic analysis of large wind turbines in the USA.** Spera, D.A. (Lewis Research Center, Cleveland, Ohio). Jan 1979.

In Implementing agreement for co-operation in the development of large scale wind energy conversion systems. First meeting of experts: seminar on structural dynamics, Munich, October 12, 1978.

Information is presented concerning computer codes used to analyze large wind turbines, the WEST hybrid wind turbine simulator, and blade stress analysis and modifications for the MOD-oA 200 kW wind turbine in Clayton, New Mexico.

44706 (SERI/PR—13-054) **Wind energy innovative systems. Technical status report, July 1978.** Vas, I.E. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1978. Contract EG-77-C-01-4042. 58p. Dep. NTIS, PC A04/MF A01.

The Solar Energy Research Institute has been authorized by the Department of Energy to provide technical management of the Wind Energy Innovative Systems (WEIS) program currently comprised of eight research and development contracts. These research efforts are aimed at determining technical and economic feasibility of innovative concepts and systems utilizing wind energy. The current report is the second of the monthly technical status reports and reviews the progress of the continuing tasks, as well as the final status of the completed tasks through June 1978. A listing of the projects and a summary of the WEIS program, indicating the important milestones for each of the projects are presented with this summary.

POWER CONVERSION SYSTEMS

44707 (SAND—79-7017) **Induction and synchronous machines for vertical axis wind turbines. Final report.** Hinrichsen, E.N. (Power Technologies, Inc., Schenectady, NY (USA)). Jun 1979. Contract EY-76-C-04-0789. 123p. Dep. NTIS, PC A06/MF A01.

The behavior of synchronous and induction generators driven by vertical axis wind turbines is described. The merits of the two types of machines are assessed. Major advantages of the synchronous generator are reactive power control and general acceptance by utility companies. The major advantage of the induction generator is excellent damping of torque pulsations. There is no significant difference in starting ability, efficiency, or voltage ripple.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 45018

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 44270

POWER CYCLES

REFER ALSO TO CITATION(S) 44248

44708 (CONF-790631—3) **Land-based application of an OTEC open-cycle power system.** Chen, F.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A02.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

OTEC power component technology may be applied to many land-based low temperature heat resources including rejected heat from thermal plants and Federal nuclear facilities, as well as freshwater thermoclines. For utilizing rejected heat from large thermal power plants where OTEC range cold water is economically available, it seems to be more cost-effective to apply OTEC open-cycle steam turbine technology for additional turbine stages for the conventional thermal power plant cycle rather than to add a separate bottoming cycle system. For utilizing rejected heat from Federal nuclear facilities, the open-cycle power system has its advantage because it does not need isolation heat exchangers to avoid cross contamination between the working fluid and the hot water supply. A simple thermal performance model and the thermal analysis of a conceptual rejected heat open-cycle power system corresponding to the binary cycle system studies by Exxon for the Oak Ridge Gaseous Diffusion Plant are presented. Rejected heat open-cycle power systems may operate at a higher thermodynamic state than OTEC systems and are closer to existing state-of-the-art technology. Thus, such systems may serve as intermediate steps toward the development of OTEC open-cycle power components and subsystems.

44709 (FE—2357-13) **CFCC development program. Quarterly report, January—March 1977.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Apr 1977. Contract EX-76-C-01-2357. 84p. Dep. NTIS, PC A05/MF A01.

The third quarter of the CFCC Development Program continued the commercial plant design evaluation with primary emphasis upon the trade-off studies not directly dependent upon the BCURA data. Plant layout drawings were prepared for the two design options as the trade-off studies continue to assess the tw

major concepts as well as optimizing other aspects of the design. Preliminary system analysis studies of seven alternate PFB coal-fired, combined-cycle power plants have been completed. These continued to demonstrate that the basic design has the best thermal efficiency at achievable temperatures. Also the CFCC cycle has the least penalty if gas turbine inlet temperature has to be reduced because of clean-up or materials limitations. Procurement of materials and fabrication of gas turbine bucket cladding test specimens continued throughtout the quarter. Seven of the cladding alloys have been applied to the discs. Four more have demonstrated fabrication feasibility and will be completed in the next month. The remainder will probably be cancelled due to fabrication difficulties. Detailed planning for the tests in the Exxon mini plant has begun. Two major problems must be resolved before an acceptable test can be defined: (a) the performance of the mini-plant without recirculation must be measured and determined to be equivalent to that expected in a commercial plant; and (b) the Ducon granular bed filter checkout must have progressed to a stage to provide a representative environment to the materials in the test section.

WASTE-FUELED SYSTEMS

44710 Three years of operating experience with a waterwall boiler at the Oceanside Disposal Plant. Hecklinger, R.S. (Charles O. Velzy Assoc., Inc., Armonk, NY); Velzy, C.O.; Kempisty, J.C. pp 417-425 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Waste heat boilers commissioned in 1965 and 1966 at the Oceanside Disposal Plant in the town of Hempstead, Long Island, New York, experienced serious tube failures commencing six months after initial operation. After a number of years of remedial effort, investigation, and observation, it was decided to replace the original forced circulation waste heat boilers with natural circulation waterwall boilers. The first replacement boiler was commissioned in June of 1974. Tube thickness measurements were made periodically of selected areas of the furnace walls and in the convection bank. Operating parameters, particularly the use of overfire air, were monitored and controlled. The operating results after 3 years have been encouraging. During this time, several modifications to operating procedures and construction details have been implemented. The second replacement boiler will be commissioned in late 1977 or early 1978.

44711 Corrosion on refuse incineration boilers, preventive measures. Nowak, F. (Techn. Werke Stuttgart, Waiblingen, Germany). pp 427-435 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Over the years, extensive investigations and experiments at the Stuttgart refuse-fired boiler plant have led to the development of a number of techniques, accomplished in the construction or operational control of these plants, that have resulted in control of the corrosion problem. The first technique involved the use of refractory coatings in the lower portion of the furnace. The second technique involved improvements in boiler configuration and design, including point of introduction of secondary air. The third technique involved regulation of the refuse feed slider, which controls the rate of feed of refuse onto the first two roller grates, by a mean furnace temperature measurement. The fourth technique for controlling corrosion is the development of optimum use of refractory and tube coatings in the lower areas of the furnace.

44712 Causes of boiler metal wastage in the Stadtwerke Duesseldorf incineration plant. Kautz, K.M. (Israel Electric Corp. Ltd., Haifa). pp 437-444 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Since the first steam generator was put into service in the Stadtwerke Duesseldorf incinerator plant in 1965 high-temperature corrosion was observed on the evaporator, final superheater and primary superheater tubes. The cause of corrosion which varied throughout the boiler was due to reducing atmospheres, high temperature chloride attack and high temperature surface attack. A relationship was found between the rate of corrosion and the increase in the amount and the heating value of the burned refuse; a further intensifying influence on the rate of metal wastage of boiler tubes could be associated with the combustion in one boiler of precrushed bulky refuse with a high wood content.

44713 Influence of heavy metals Pb and Zn on corrosion and deposits in refuse-fired steam generators. Kerekes, Z.E.; Bryers, R.W.; Sauer, A.R. (Foster Wheeler Development Corp., Livingston, NJ). pp 455-472 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

The burning of refuse in waterwall-cooled steam generators to reduce its bulk and provide an inexpensive source of energy from a low-sulfur fuel has introduced new corrosion and deposit problems. The cause for alarm that refuse might be a severe fouling and corrosive fuel originated from experience with the European units placed into service in the mid-1960s. To gain a better understanding of the cause of fireside problems resulting from the combustion of refuse, a program was initiated which included an extensive literature survey, visits to field installations and a comprehensive analysis of samples removed from tube surfaces at various installations. This study showed that corrosion in refuse-fired steam generators is quite complex. Several mechanisms for attack seem to be occurring simultaneously under similar environmental conditions making it difficult to discern just what is the cause. The design and operation of the steam generator seem to have a bearing on the problem which adds to the difficulty of interpreting laboratory experimentation. The heavy metals, lead and zinc, in the form of chlorides of lead sulfates and chlorides of zinc contribute to the corrosion in refuse-fired steam generators. It is doubtful that corrosion is due to pyrosulfate or complex alkali-iron sulfates. Although refuse is a heterogeneous fuel, the problems appear to be similar in many steam generators. Differences are probably due to variations in internal environmental conditions and operational parameters, and time-to-time deviation of presence of the various corrosion-causing elements. Proper refuse preparation and mixing, with improved steam generator design and controlled operational procedures can be effectively exercised to minimize the catastrophic corrosion problems and reduce deposit phenomena in refuse-fired operations.

44714 Chloride corrosion and its inhibition in refuse firing. Vaughan, D.A.; Krause, H.H.; Boyd, W.K. (Battelle Columbus Labs., OH). pp 473-493 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Fireside corrosion from burning of municipal refuse alone and with high-sulfur coal was investigated in field studies by the use of corrosion probes. Corrosion rates of simulated boiler tubes were measured for periods up to 828 hours for carbon steel, low alloy steel, and stainless steels in an incinerator burning bulk refuse. Similar experiments were conducted in co-firing of shredded refuse with high-sulfur coal in a stoker-fired boiler. Detailed analysis of deposits, corrosion scale, and substrate metal showed that chlorine in the refuse is responsible for the most serious corrosion. Sulfur, sodium, potassium, lead, and zinc also take part in the corrosion reactions. The addition of sulfur to bulk refuse reduced the corrosion rates of carbon steel and stainless steels significantly. In the co-firing of refuse-coal mixtures the initial corrosion rates of carbon steel were about an order of magnitude lower than those for 100% refuse, while those for stainless steels were 10 to 50 times lower.

COMPONENTS

REFER ALSO TO CITATION(S) 44273, 44284, 44332, 44333, 44334, 45123

44715 (PB—286707) **EPA utility FGD survey: April—May 1978. Periodic report, March—July 1978.** Laseke, B.; Melia, M.; Smith, M.; Fischer, W. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Sep 1978. Contract EPA-68-01-4147. 139p. NTIS PC A07/MF A01.

The report is an updated supplement to EPA-600/78-051a (PB-279 011) and should be used in conjunction with it. It presents a survey of utility flue gas desulfurization (FGD) systems in the U.S., summarizing information contributed by the utility industry, process suppliers, regulatory agencies, and consulting engineering firms. Systems are tabulated alphabetically, by development status (operational, under construction, in planning stages, or terminated operations), by utility company, by process supplier, by process, by waste disposal practice, and by regulatory class. It presents data on system design, fuel sulfur content, operating history, and a actual performance. It discusses problems and solutions associated with the boilers and FGD systems. Process flow diagrams and FGD system economic data are appended to the report.

44716 (RI/RD—78-212) **Advanced coal-fueled combustor/heat exchanger technology study. Final report, March 1977—June 1978.** (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 1978. Contract EF-77-C-01-2612. 42p. Dep. NTIS, PC A03/MF A01.

This report is concerned with the design of coal-fired combustor/heat exchangers suitable for inputing the heat to base-loaded, closed-cycle, gas turbine, 350 MWe, central station power generation systems. A wide variety of CCGT cycles are evaluated to establish the performance requirements for the combustor/heat exchanger. The cycles finally selected for combustor/heat exchanger design operate at 1550 F, 1750 F, and 2250 F maximum working-fluid temperatures. Each selected cycle is bottomed with a Rankine/steam cycle operating at 2400 psi/1050 F/1050 F. The coal inputs to stations incorporating the selected angles are estimated to range between 82 and 88% of the required input to a 2400-psi/1000 F/1000 F conventional steam station. At the 1550 F maximum working-fluid temperature, two combustor/heat exchanger preliminary designs are created, one utilizing the pulverized-coal-fired, dry-bottom furnace firing concept and the other utilizing the atmospheric-pressure, fluidized bed with limestone addition firing concept. In both designs, all heat exchanger surface is metal. At the 1750 F maximum working-fluid temperature, the combustor/heat exchanger preliminary design is based on a series arrangement of high- and low-temperature fluidized beds. At 2250 F maximum working-fluid temperature, the combustor/heat exchanger preliminary design is based on the slagging cyclone combustor concept. Heat exchanger surface exposed to working-fluid temperatures above 1550 F is constructed of silicon carbide. The key technical features of the four preliminary designs areidentified and analyzed. Research and development programs to advance the technology of these designs to a state of readiness for commercial application are outlined, and R & D cost estimates are presented. The cost of electricity produced in 700 MWe stations incorporating the studied CCGT cycles and combustor/heat exchangers is estimated and compared with the cost of electricity in conventional steam stations.

44717 Means and method for the destruction of particles entrained in a gas stream. Botts, T.E.; Powell, J.R. (to Dept. of Energy). US Patent Application 934,552. 17 Aug 1978. 16p.

Destruction in the context of the subject invention means the fragmentation and/or vaporization of particles above a certain size limit. The invention contemplates destroying such particles by exposing them to intense bursts of laser light, such light having a frequency approximately equal to or less than the mean size of such particles. The invention is particularly adapted to the protection of turbine blades in open cycle coal-fired turbine systems. Means for introducing various chemical species and activating them by exposure to laser light are also disclosed.

44718 Improved thermal efficiency by control of factors affecting metal wastage in pulverized coal-fired steam generators. Borio, R.W.; Plumley, A.L.; Sylvester, W.R. (C-E Power Systems, Windsor, CT). pp 163-183 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

One available option is to increase the thermal efficiency of conventional pulverized coal-fired plants by increasing steam temperature (and pressure) to the turbines. With this option, however, there is concern: that the materials of construction will not give long-term, satisfactory performance at the higher temperatures; over increased use of alloying elements such as chromium and nickel, which are, in the long term, of critically short supply; that higher steam temperatures will adversely affect unit reliability and availability; and for coal ash corrosion of the superheater and reheater materials operating at higher temperatures. This paper considers coal ash corrosion and boiler reliability/availability as affected by corrosion. This is done by reviewing the extensive knowledge available on the subject, discussing current research, and examining those areas requiring additional research.

44719 Corrosion/deposition in fluidized bed combustion power plant systems. Kearns, D.L.; Alvin, M.A.; O'Neill, E.P.; Spengler, C.; Clark, J.; Hamm, J.R.; Sverdrup, E.F. (Westinghouse R and D Center, Pittsburgh, PA). pp 497-523 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Control of material corrosion, deposition, and erosion is required to demonstrate commercial fluidized bed combustion systems. The primary areas of concern are the heat transfer surface materials in atmospheric and pressurized systems and gas turbine expander materials used in pressurized systems. An understanding of the source of gaseous contaminants and particulates; the gaseous and particulate compositions throughout each fluidized bed combustion concept; the corrosion, deposition, and erosion potential under specified operating conditions; and the tolerance of alternative materials to the respective design and operating parameters is required in order to design a reliable and cost effective fluidized bed combustion process. The scope of this assessment is limited to questions of material corrosion. Fluidized bed combustion power plant concepts are reviewed and reference operating parameters identified. Corrosive contaminants, corrosion potential, and materials selection are discussed, with emphasis on the gas turbine expander utilized in pressurized systems.

44720 Materials tests for an indirect air cooled PFBC combined cycle power plant. Wolosin, S.M. (Curtiss-Wright Corp., Wood-Ridge, NJ). pp 581-588 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Results of a laboratory test program to evaluate alloys and coatings for use in a high sulfur coal fired PFB combined cycle system are reported. Erosion testing at 871°C on nickel and cobalt base alloys and coatings indicated erosion of vertically oriented heat exchanger tubes in a PFB combustor will not be significant at low (0.82 m/sec) bed velocities. Combined hot corrosion erosion testing at 871°C on nickel and cobalt base turbine alloys and coatings revealed that cobalt-base super alloys exhibit better resistance against hot corrosion-erosion than nickel-base superalloys, and coatings provide excellent corrosion-erosion resistance in a particulate laden high velocity (91.4 m/sec) gas stream.

44721 Detector and process for determining discontinuity of flow in a gas turbine drive. Elsaesser, F.L.; Hall, J.H. (to United Technologies Corp., East Hartford, CT (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,652,729/A/. 26 May 1977. 29p. (In German).

The patent is claimed for a process, where the temporal coincidence of two events in the operation of a gas turbine drive is used as a criterion of threatened discontinuity of flow. Each of these events to be determined by continuous measurment supplies part of a signal to an AND gate. On simultaneous arrival of both parts of the signal this circuit gives a warning signal of discontinuity of flow or introduces immediate counter measures into the necessary sequence. In order to avoid spurious alarms due to so called 'wipers' occuring for short periods, the warning signal can be delayed for a short time, i.e., can only be given after the first and/or second part of the signal exist for some seconds. The first part of the signal is given by the fuel regulator, which shows that the fuel fed to the drive has the minimum value. A second part of the signal stems from an operating parameter, if this deviates from tbe nominal value, which corresponds to the position of the fuel regulator. Either air pressure at or near the compressor or the pressure at the compressor outlet, or the temperature at or near the turbine or at the turbine inlet or outlet, act as the operating parameter for the second part of the signal, if its rate of change of reduction reaches a predetermined value. Finally the second part of the signal can only be emitted if the fuel supply takes place according to the acceleration programme (from scanning of the fuel regulator).

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 44708, 44892, 44898, 44899

ECONOMICS

REFER ALSO TO CITATION(S) 44901, 44929

44722 (PB—288798) An evaluation of a procedures manual for assessing the socioeconomic impact of the construction and operation of coal utilization facilities in the Old West Region. Final report. (Western Analysts, Riverton, WY (USA)). Nov 1975. Contract OWRC-10570075. 103p. NTIS PC A06/MF A01.

The report is one of two volumes detailing the results obtained by applying the manual to the construction of a proposed electric generating station on the Laramie River near Wheatland, Wyoming.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 44868, 44959

FUELS

REFER ALSO TO CITATION(S) 44274, 44913

44723 (PB—287937) Low-sulfur western coal use in existing small and intermediate size boilers. Final report Feb 1975—Feb 1978. Maloney, K.L.; Moilanen, G.L.; Langsjoen, P.L. (KVB, Inc., Tustin, CA (USA)). Jul 1978. Contract EPA-68-02-1863. 444p. NTIS PC A19/MF A01.

The report gives results of testing of 10 representative coal-fired boilers in the Upper-Midwest, including an assessment of SO,

NO, CO, unburned HC, and particulate emissions from these units, as well as an assessment of the operational impact of coal switching. The study showed that western subbituminous coals can be substituted for eastern bituminous coals as an industrial boiler fuel. Western coals are compatible with industrial coal-fired units of current design. Two unit types of older design (underfed and traveling grate stokers) experienced difficulty burning western coal. In some cases, the boiler's maximum load capacity had to be limited, a problem that can be eliminated by predrying the coal or by increasing superheat steam attemperation capacity. Western subbituminous coals were superior to eastern coals in terms of SO, NO, particulate, and unburned HC emissions. Western coals could be fired at lower excess air and exhibited substantially lower combustible losses than eastern coals. The size of delivered western coal was a problem in most of the stoker-fired units tested: it generally had too large a percentage of fine coal, caused by its poor weathering characteristics. Stoker performance on western coal can be improved by sizing the coal at the point of use, to reduce delivery distances to about 200 miles.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44930, 45343, 45350, 45351, 45354, 45459

44724 (PB—286594) **The valuation of aesthetic preferences.** Brookshire, D.S.; Ives, B.C.; Schulze, W.D. (New Mexico Univ., Albuquerque (USA). Dept. of Economics). 1976. 50p. NTIS PC A03/MF A01.

This paper reports on a bidding game applied to estimate aesthetic damages from possible construction of the Kaiparowits power plant near Lake Powell. Three problems associated with the interpretation of bidding games are explored theoretically and empirically: (1) incentives for biased responses; (2) divergences between compensating and equivalent variation; and (3) problems of interpersonal comparison in the aggregation of individual bids.

44725 (PB—286629) **Larval fish distributions in southwestern Lake Erie near the Monroe Power Plant. Report for 1 April 1976-1 April 1978.** Cole, R.A. (Michigan State Univ., East Lansing (USA). Inst. of Water Research). Jul 1978. 76p. NTIS PC A05/MF A01.

This paper presents and discusses studies of larval fish distribution near a large power plant on western Lake Erie using methods that attempt to account for the confounding effect of environmental variation on technique effectiveness. Distributions in the coastal zone were sampled with daytime and nighttime tows of 1-m plankton nets. Density and mortality were also sampled in the cooling system of the Monroe Power Plant. Certain species of larvae seemed to be more vulnerable to entrainment than others: gizzard shad were more vulnerable than yellow perch, white bass, rainbow smelt, shiners (Notropis) carp and goldfish.

44726 (PB—286758) **Cooling tower effects on native perennial vegetation. August 1972-April 1975. Volume I. Sections I-IX. Preoperational report.** Curtis, C.R.; Lauver, T.L.; Francis, B.A. (Maryland Univ., College Park (USA). Water Resources Research Center). Apr 1976. 64p. NTIS PC A04/MF A01.

This document represents a summary of studies on perennial vegetation completed during the period August, 1972-April, 1975 which preceded the initiation of cooling tower operations at Chalk Point, Maryland. The study gives variables in soils, annual vegetation, and perennial vegetation under conditions prevalent prior to completion and operation of the cooling tower. Also these variables are given after the towers became operational. Environmental impact of saline drift on the surrounding area is reported with particular attention to tobacco and other agronomic crops, on perennial vegetation, and on soils of the vicinity. (Color illustrations reproduced in black and white)

44727 (PB—287862) **Factors affecting accuracy of ichthyoplankton samples used in power plant entrainment studies. Topical briefs report.** Bowles, R.R.; Merriner, J.V.; Boreman, J. (National Plant Power Team, Ann Arbor, MI (USA); Virginia Inst. of Marine Science, Gloucester Point (USA)). Jun 1978. 19p. NTIS PC A02/MF A01.

Sampling programs designed to assess impact of power plants on ichthyoplankton populations are subject to multiple sources of error that may affect reliability and applicability of the data. Gear currently used to sample ichthyoplankton are discussed, and abiotic and biotic factors that may prevent these gear from attaining representative samples are identified. A check list of items which should be considered in evaluation of existing or proposed programs to sample ichthyoplankton is provided.

44728 (PB—289586) **Comparison of simulation models used in assessing the effects of power-plant-induced mortality on fish populations. Technical report.** Swartzman, G.L.; Deriso, R.B.; Cowan, C. (Washington Univ., Seattle (USA). Center for Quantitative Science in Forestry, Fisheries, and Wildlife). Oct 1978. Contract NRC-04-75-222. 169p. NTIS PC A08/MF A01.

Eight models predicting the impact of power plant operation upon economically important fish species are compared. The paper focuses on the effect differences between the models have on model predictions. Generalized model simulators were developed for the young-of-the-year and life-cycle submodels. Criteria used to evaluate model predictions are percentage of reduction in young-of-the-year and annual loss in yield to the fishery due to plant operation. Major differences between the models include the life stage lengths, density-dependent or density-independent young-of-the-year fish to age class 1. Major differences in parameter values include entrainment factors, total egg production, equilibrium population size, and survival probabilities for the life-cycle models. Recommendations are made regarding our preference for model approaches.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 45365, 45400, 45402, 45454

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 44223, 44259, 44260, 44275, 44284

44729 (LBL—8849) **Characterization of NOx removal through ammonia addition.** Eitzen, T.S.; Brown, N.J.; Newton, A.S.; Gordon, A.K.; Basden, K.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 38p. (WSS/CI—79-22; CONF-790434—4). Dep. NTIS, PC A03/MF A01.

From Spring meeting on western states section, and the Combustion Institute; Provo, UT, USA (23 Apr 1979).

A new NO control technology has been described by Lyon and Longwell which selectively removes NO from combustion effluent gases through homogeneous reactions with ammonia and oxygen. The process is different from conventional NO abatement techniques since it does not prevent or limit NO formation but rather removes the NO through reaction in the post combustion gases. Since the process does not differentiate between thermal and fuel NO, and selectively removes NO after its formation, it reduces both thermal and fuel NOx. The present paper is concerned with characterizing the selective reduction of NO through the addition of NH_3 to the post combustion gases. The study was undertaken in a laboratory scale combustion tunnel that supports steady state reproducible combustion under a variety of operating conditions. Propane fuel was premixed with air and the prototype fuel nitrogen compound, NO, prior to combustion. Experimental variables considered in the study are: (1) equivalence ratio, (2) NO concentration prior to ammonia addition, (3) temperature of the combustion products prior to ammonia addition, and (4) ammonia concentrations added to the product gases. Results are analyzed in terms of NO survival yields. The characterization process for the selective reduction of NO through reaction with NH_3 added to the post combustion gases has involved kinetic studies, laboratory scale combustor studies and demonstration studies in utilities, and these provide different but complementary information.

44730 (PB—286611) **EPA evaluation of Bahco industrial boiler scrubber system at Rickenbacker AFB. Final report, March 1976-June 1977.** Biedell, E.L.; Ferb, R.J.; Malamud, G.W.; Ruff, C.D.; Stevens, N.J. (Research-Cottrell, Inc., Bound Brook, NJ (USA)). Jun 1978. Contract F33617-75-90100. 226p. NTIS PC A11/MF A01.

A comprehensive test program which characterized the particulate removal, sulfur dioxide removal, operating costs, maintenance costs, waste product properties operating experience and capacity of a size 50 R-C/Bahco scrubbing system installed to treat flue gas from coal fired boilers at Rickenbacker AFB, Columbus, Ohio, was completed. Tests were conducted over an 18 month period during which 27,216 tons of coal were burned. The results from this program demonstrate that this system is capable of controlling both particulate and sulfur dioxide emissions from the combustion of high sulfur (2-4%) mid-Western coal at firing rates from 20 MM to 200 MM Btu/hr. A cost of $4.27 per ton for optimum operation with limestone was projected. Waste product properties relative to dewatering handling and disposal were found to be similar to those measured for other FGD waste products.

44731 (PB—288204) **EPA industrial boiler FGD survey: third quarter 1978. Final report.** Tuttle, J.; Patkar, A.; Welch, D.; Hessling, M.; Eckstein, M. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Nov 1978. Contract EPA-68-02-2603. 175p. NTIS PC A08/MF A01.

The report presents detailed technical information concerning application of flue gas desulfurization (FGD) systems to industrial boilers. Design and operation data is presented for 161 FGD control

systems (121 of them operational), designed to control SO_2 emissions from 147 industrial boilers at 57 plants. With a 1978 capacity of 9.3 million scfm, an average of more than seven new FGD systems have been put on line each year since 1972. Information in the report was obtained by a survey of plant personnel, control system vendors, regulatory agencies, and consulting engineering firms. The data is given in two types of tables: one gives summary information; the other, detailed information. Summary tables present information as a function of control process, control system vendor, disposal technique, operational status, start-up date, and flue gas capacity. Detailed information includes: control system design, economics, operating experience, problems and solutions, waste disposal techniques, and maintenance practices.

44732 (PB—288299) **EPA utility FGD survey: June—July 1978. Periodic report Jun—Jul 1978.** Melia, M.; Smith, M.; Fischer, W.; Laseke, B. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Nov 1978. Contract EPA-68-02-2603. 138p. NTIS PC A07/MF A01.

The report is an updated supplement to PB-279 011 and should be used in conjunction with it. It presents a survey of utility flue gas desulfurization (FGD) systems in the U.S., summarizing information contributed by the utility industry, process suppliers, regulatory agencies, and consulting engineering firms. Systems are tabulated alphabetically, by development status (operational, under construction, in planning stages, or terminated operations), by utility company, by process supplier, by process, by waste disposal practice, and by regulatory class. It presents data on system design, fuel sulfur content, operating history, and actual performance. It discusses problems and solutions associated with the boilers and FGD systems. Process flow diagrams and FGD system economic data are appended to the report.

44733 **Prevention of scale formation in wet lime scrubbers.** Agarwal, J.C.; Giberti, R.A.; Petrovic, L.J. (to Kennecott Copper Corp.). US Patent 4,148,615. 10 Apr 1979. Filed date 30 Mar 1976. 6p.

The invention pertains to a method for reducing scale formation in wet lime and limestone sulfur dioxide scrubbers; more particularly, the invention pertains to a method for improving air quality standards by providing a less troublesome sulfur dioxide removal from power plant stack gases or reverberatory furnace waste gases. Still further, the invention pertains to a method for operating a wet lime or limestone scrubber for the purpose of obtaining a substantially completely sulfur dioxide free flue or furnace gas.

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 44724

44734 (PB—288517) **Energy facility siting and licensing. Annotated bibliography 1970-1978.** Nakamura, S.L. (Atomic Industrial Forum, Inc., Washington, DC (USA)). 1978. 155p. NTIS PC E12/MF E12.

A selective annotated bibliography on the siting and licensing of power plants and associated energy facilities is presented. Data was extracted from the Atomic Industrial Forum's INFORUM Data Base which contains abstracts from environmental reports, environmental impact statements and generic studies. The items referenced in the bibliography are selected studies, appendices, tables and figures representing siting studies and analyses developed by the electric power industry, their consultants and regulatory agencies. The first three sections of the bibliography focus on generic studies prepared by state and federal regulatory agencies, analytical assessment techniques used by industry and factors influencing siting decisions such as population, land use, geology, transportation, transmission and fuel. Section four identifies candidate areas for potential plants, specific alternative site locations, cost benefit analyses, and early site review studies. Section five contains personal and corporate author indexes and a geographical index.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 44924, 44925, 44926, 44927, 44928, 45154

44735 (PB—288190) **Automatic generation control--notes and observations.** Gish, W.B. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). Oct 1978. 32p. NTIS PC A03/MF A01.

The concept of automatic generation control is often considered complex because of the freedom each utility has in choosing individual characteristics within a basic control philosophy. This report endeavors to separate the basic philosophy from the individual characteristics to allow a clearer understanding of the control philosophy. Discussions of individual characteristics used by the Bureau of Reclamation are also presented.

AC SYSTEMS, EHV AND UHV

44736 (COO—4206-7) **Security assessment of power systems including energy storage. Progress report, October 1—December 31, 1978.** Carroll, D.P.; Triezenberg, D.M. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Jan 1979. Contract EC-77-S-02-4206. 26p. Dep. NTIS, PC A03/MF A01.

Work has continued on the simplified model of a current-fed, force-commutated converter (CFFCC) interface for systems with inductor-converter (IC) energy storage. A digital simulation has been developed to study in detail certain abnormal modes of operation for possible inclusion in the simplified CFFCC model. Eigenvalue studies are being performed to aid in the formulation of energy storage control designs for dynamic stability applications. A computer simulation has been developed for a multi-machine power system, and is being used to study the effectiveness of real and reactive power modulation of energy storage in transient stability control. The special task on the application of a small IC unit for damping of the BPA system has been completed. The control design has been verified by computer simulations, which use a measured transfer function approach as well as physically-based equivalent models.

44737 (COO—4376-T1) **Feasibility study of an active system for transformer noise abatement.** Yannucci, D. (Westinghouse Electric Corp., Sharon, PA (USA). Medium Power Transformer Div.). May 1979. Contract EE-77-C-02-4376. 60p. Dep. NTIS, PC A04/MF A01.

The purpose of this project was to demonstrate the feasibility of noise abatement of medium power transformers by means of a novel concept for active sound suppression. Noise abatement was accomplished by destructive interference of sound pressure fluctuations in three narrow frequency bands centered at 120, 240, and 360 Hz. The project included the design and construction of a model transformer; design, fabrication, and testing of two active sound cancellation units; and a cost analysis comparing the active system with conventional transformer sound abatement methods. Initial goals, considered representative of a typical substation type transformer, were established at 20-, 15-, and 13-dB reductions in sound levels at 120, 240, and 360 Hz, respectively. Measurements in 10-Hz bands centered at 120, 240, and 360-Hz indicated that the goals were achieved on the side of the model transformer on which the sound cancellation units were attached. Measurements in octave bands centered at 125, 250, 500, and 1000 Hz showed the greatest sound reduction, 16.3 dB, in the 250-Hz band, which contains both the 240-Hz and 360-Hz harmonics. The A-weighted sound level was reduced 2.6 dB at the treated face, but was found to be enhanced 2.1 dB at the opposite face. This indicates that the 120-, 240-, and 360-Hz harmonics contain only a small fraction of the total sound energy radiated by the model transformer, and that the treatment of only one transformer face may not result in a satisfactory sound reduction in all directions. The economic analysis shows an advantage for the active noise abatement system. This conclusion needs to be verified by independent analysis. The main advantage appears to lie in its ability to handle low-frequency, high-amplitude signals at about the same cost as high-frequency signals. This feasibility study indicated the potentials of a two-dimensional system under selected conditions.

DC SYSTEMS

44738 (N—78-29349) **Measurement techniques for the characterization in the frequency domain of regulated energy-storage dc-to-dc converters. M.S. thesis.** Bahler, D.D. (Duke Univ., Durham, NC (USA). Dept. of Electrical Engineering). 16 Aug 1978. Contract NGL-34-001-001. 111p. NTIS PC A06/MF A01.

Procedures are presented for obtaining valid frequency-domain transfer functions of regulated reactor energy-storage dc-to-dc converters. These procedures are for measuring loop gain, closed loop gain, output impedance, and audio susceptibility. The applications of these measurements are discussed.

NUCLEAR POWER PLANTS

44739 **Progress in the development of explosives materials detectors.** Williams, W.D.; Conrad, F.J.; Sandlin, L.L.; Burrows, T.A. (Sandia Lab, Albuquerque, NM). *Nucl. Mater. Manage.;* 7: 431-437(1978).

Five hand-held explosives vapor detectors were evaluated for sensitivity to a variety of explosives, identification of false alarm agents, and general performance and maintenance characteristics. The results of this evaluation, as presented, indicate that there is no single explosives detector which is best-suited for use at all nuclear

facilities. Rather, there are several site-specific elements which must be considered when choosing an explosives detector. This paper discusses the following areas of explosives detection research: nitrogen-phosphorous detectors, plasma chromatography, mass spectroscopy, small animal olfactory, vapor preconcentration, nuclear quadrupole resonance, far infrared radiation imaging, nuclear magnetic resonance, thermal neutron activation, and computerized tomography.

44740 International co-operation in the nuclear field: perspectives and prospects. Paris, France; OECD (1978). 137p. (CONF-780276—).

From International co-operation in the nuclear field: Perspectives and prospects; Paris, France (Feb 1978).

Contributions from representatives of several participating countries are included. Topics covered included various aspects of international cooperation in nuclear power research and development.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 44753, 44799, 44814, 44835, 44838, 44842, 44843, 44844, 44845, 44855, 44889

44741 (BNL-NUREG—24936) **Analysis of Peach Bottom turbine trip tests.** Cheng, H.S.; Lu, M.S.; Hsu, C.J.; Shier, W.G.; Diamond, D.J.; Levine, M.M.; Odar, F. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790519—4). Dep. NTIS, PC A02/MF A01.

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

Current interest in the analysis of turbine trip transients has been generated by the recent tests performed at the Peach Bottom (Unit 2) reactor. Three tests, simulating turbine trip transients, were performed at different initial power and coolant flow conditions. The data from these tests provide considerable information to aid qualification of computer codes that are currently used in BWR design analysis. The results are presented of an analysis of a turbine trip transient using the RELAP-3B and the BNL-TWIGL computer codes. Specific results are provided comparing the calculated reactor power and system pressures with the test data. Excellent agreement for all three test transients is evident from the comparisons.

44742 (EPRI-NP—332) **Evaluation of operational techniques that can reduce radiation fields in LWRs during maintenance. Final report.** Keneshea, F.J.; Knecht, P.D.; Doyel, D.; Zahner, R. (Nuclear Services Corp., Campbell, CA (USA)). Mar 1979. 258p. Dep. NTIS, PC A12/MF A01.

A survey has been made of operating nuclear stations by Nuclear Services Corporation to determine the chemical and operational techniques being used to reduce shutdown and primary system radiation fields. Seven boiling reactor (BWRs) and seven pressurized water reactors (PWRs) were visited and several more plants were contacted by questionnaire and by telephone.

44743 (EPRI-NP—1021) **Determination of fit-up stresses in the recirculation bypass line in the Brunswick 1 Reactor.** Egan, G.R.; Cipolla, R.C.; Oritz, K. (Failure Analysis Associates, Palo Alto, CA (USA)). Mar 1979. 60p. Dep. NTIS, PC A04/MF A01.

The report describes the execution of a strain gage plan to determine fit-up stress levels in a bypass line in the recirculation system of a boiling water reactor. In addition to the experimental work, an analysis method is developed to determine the forces and moment acting throughout the line using the results from a limited number of strain gage locations. The general level of stress measured and calculated in the line was low. The peak axial strain measured with strain gages gave a tensile stress of 2.3 ksi at the outlet-side weldolet. The analysis showed that the maximum calculated axial stress in the line occurred at the inlet-side elbow with a magnitude of 4.3 ksi. This level of stress is the sum of construction fit-up and dead weight and is not significant when compared with total stress levels in BWR bypass lines from service-induced and residual welding stresses.

44744 (EPRI-NP—1022) **Requirements for analysis of transient fuel rod behavior during design basis events. Final report.** Burchill, W.E. (Combustion Engineering, Inc., Windsor, CT (USA)). Mar 1979. 211p. Dep. NTIS, PC A10/MF A01.

Potential licensing application for a transient fuel rod behavior computer code are identified and characterized. Fifteen design basis event categories, encompassing forty-nine design basis events, are examined to define the fuel rod behavior modeling requirements for licensing applications. Present regulatory requirements and guidelines are discussed as well as code system-model characteristics and interface and operational requirements. This report establishes the basis for a detailed evaluation of the applicability of an advanced transient fuel rod behavior computer code to be used in nuclear steam supply system licensing analyses. In addition, this report evaluates the applicability of a current state-of-the-art fuel rod behavior code(FRAP-T3) to licensing analysis, and suggests potential future fuel rod model development activities.

44745 (EPRI-NP—1042) **Development of the criticality capability for the SAM-CE Monte Carlo System.** Lichtenstein, H.; Troubetzkoy, E.; Steinberg, H.; Cohen, M.O. (Mathematical Applications Group, Inc., Elmsford, NY (USA)). Apr 1979. 41p. Dep. NTIS, PC A03/MF A01.

A criticality capabilty has been developed and implemented in the SAM-CE Monte Carlo system. The data processing component, SAM-X, preserves, to any required accuracy, the data quality inherent in the ENDF/B library. The generated data is Doppler-broadened and includes (where applicable) probability tables for the unresolved resonance range, and thermal-scattering law data. Curves of several total and partial cross sections are generated and displayed. The Monte Carlo component, SAM-F, includes several eigenvalue estimators and variance reduction schemes. Stratification was found to effect significant improvement in calculational efficiency, but the usefulness of importance sampling is marginal in criticality problems. The entire system has been installed at BNL, for the analysis of TRX benchmarks. The TRX-1 and TRX-2 cell calculations have been performed, with estimated eigenvalues of 1.1751 +- 0.0016 and 1.1605 +- .0015, respectively. These results are shown to be statistically consistent with other sources.

44746 (EPRI-NP—1076-SR) **RETRAN analysis of the turbine trip tests at Peach Bottom Atomic Power Station Unit 2 and at the end of cycle 2. Special report.** Hornyik, K.; Naser, J.A. (Oregon State Univ., Corvallis (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Apr 1979. 212p. Dep. NTIS, PC A10/MF A01.

The RETRAN system analysis code is undergoing a comprehensive qualification program by the Electric Power Research Institute and the Utilities' RETRAN Working Group. An important element of this effort is the analysis of the turbine trip tests performed at the Peach Bottom Atomic Power Station Unit 2 boiling water reactor (BWR) during April 1977. The report gives the results obtained from this analysis and from an extensive set of associated sensitivity studies. These results are in good agreement with the measured data, providing important evidence of the code's ability to model BWR turbine trips and similar transients. Other conclusions resulting from this work pertain to needed code improvements and to the sensitivity of the calculated transients to various input parameters. The analysis of the tests and the sensitivity studies performed with RETRAN also provide a better understanding of certain phenomena which are important during BWR transients involving abrupt changes in pressure and flow.

44747 (HEDL-SA—1719) **Development and testing of standardized procedures and reference data for LWR surveillance.** McElroy, W.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1979. Contract EY-76-C-14-2170. 63p. (CONF-790234—1). Dep. NTIS, PC A04/MF A01.

From IAEA specialists' meeting; Vienna, Austria (26 Feb 1979).

The resources and talents of many national and international organizations and laboratories, both governmental and industrial, are being used to establish analysis methods for predicting the embrittlement condition of light water reactor (LWR) primary systems. The exact interrelationships and responsibilities between those developing, understanding, combining, and applying state-of-the-art technology in dosimetry, metallurgy, and fracture mechanics for reactor systems analysis are being carefully reviewed and studied. This has resulted in a more comprehensive definition of the scope of new and updated ASTM standards required for the analysis and interpretation of LWR pressure vessel surveillance results. Fifteen new and updated ASTM standards have now been identified, together with a restructuring of the main interfaces between the individual standard practices, guides, and methods. The paper briefly discusses these standards and the initial results of multi-laboratory research work involved in their validation and calibration.

44748 (NUREG/CR—0650) **Comparative evaluation of containment spray additives: detrimental impacts of an inadvertent spray actuation.** Postma, A.K.; Tam, P.S. (Benton City Technology, WA (USA)). Apr 1979. 37p. NTIS.

The report presents the results of an engineering analysis of detrimental health and economic impacts of inadvertent operation of a containment spray system. Injection spray solutions of plain water, boric acid, boric acid with hydrazine, boric acid with sodium hydroxide, and sodium borate with sodium thiosulfate were considered. It was concluded that none of the solutions would represent an acute toxicity problem to people in the containment vessel at the time of

an unwanted spray system trip. Also, corrosion to safety-related equipment was found to be negligible. The major effect of spray additive type in an inadvertent spray operation appears to be the level of effort required to recover from the incident. None of the detrimental effects brought to light in this study appear to play a determining role in the selection of spray additive type.

44749 (UCID—18117) **Effects of torus wall flexibility on forces in the Mark I BWR pressure suppression system: extended analyses under SRV T-quencher loading.** Holman, G.S.; Lu, S.C.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1979. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

Extended analyses are presented for possible fluid/structure interaction (FSI) effects for SRV teequencher test results. Three input pulses with total impulses varying by up to a factor of five are applied to two-dimensional finite-element models of the Mark I torus with shell diameter-to-thickness ratios of 0, 300, and 600. The results of these analyses support earlier conclusions that increased wall flexibility enhances attenuation of hydrodynamic loads and furthermore indicate that the magnitude of the attenuation is only weakly affected by the total impulse of the bubble pressure time—history.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 44742, 44744, 44745, 44747, 44748, 44814, 44835, 44836, 44838, 44839, 44840, 44841, 44842, 44844, 44845, 44847, 44850, 44852, 44853, 44855, 44856, 44859, 45262

44750 (CONF-790646—2) **Zircaloy sheathed thermocouples for PWR fuel rod temperature measurements.** Anderson, J.V.; Wesley, R.D.; Wilkins, S.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 28p. Dep. NTIS, PC A03/MF A01.

From International colloquium on irradiation for reactor safety programmes; Petten, Netherlands (25 Jun 1979).

Small diameter zircaloy sheathed thermocouples have been developed by EG & G Idaho, Inc., at the Idaho National Engineering Laboratory. Surface mounted thermocouples were developed to measure the temperature of zircaloy clad fuel rods used in the Thermal Fuels Behavior Program (TFBP), and embedded thermocouples were developed for use by the Loss-of-Fluid Test (LOFT) Program for support tests using zircaloy clad electrically heated nuclear fuel rod simulators. The first objective of this developmental effort was to produce zircaloy sheathed thermocouples to replace titanium sheathed thermocouples and thereby eliminate the long-term corrosion of the titanium-to-zircaloy attachment weld. The second objective was to reduce the sheath diameter to obtain faster thermal response and minimize cladding temperature disturbance due to thermocouple attachment.

44751 (DLCS—5000478) **[Shippingport Atomic Power Station]. Quarterly operating report, fourth quarter 1978.** (Duquesne Light Co., Shippingport, PA (USA)). 1978. Contract EY-76-C-11-0292. 22p. Dep. NTIS, PC A02/MF A01.

During the quarter, the station was operated for Duquesne Light Company system grid including base load and swing load operation. Forty-three (43) swing load operations have been performed on the LWBR Core this quarter to meet the LWBR operating plan of fifty (50) during this operating phase. The LWBR Core has generated 8879.48 EFPH from start-up through the end of the quarter. The generator load factor this quarter was 79%.

44752 (DOE/TIC—10111) **Rod deformation and cladding reactions in a PWR fuel rod cluster: results of test PCM-5.** Owen, D.E.; Kerwin, D.K.; Smith, R.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

The Thermal Fuels Behavior Program of EG & G Idaho, Inc., has conducted irradiation tests since 1975 for the U.S. Nuclear Regulatoy Commission to determine the effects of operation in overpower or undercooling modes on pressurized water reactor (PWR) type fuel rods. Highly instrumented single-rod tests, performed in the power-cooling-mismatch (PCM) test series, have produced extensive data on the coolant thermal-hydraulic conditions required to produce departure from nuclear boiling (DNB) and the consequences to Zircaloy cladding integrity of sustained film boiling operation. Test PCM-5, the first nine-rod cluster test of the PCM test series, (a 3 x 3 rod array within a flow shroud) was performed in May 1978 to (a) assess film boiling behavior of a fuel rod in a configuration representative of power reactor fuel bundles, and (b) to determine whether rod-to-rod DNB propagation or failure propagation would occur. Test results are discussed.

44753 (EPRI-NP—1056) **Measurement and analysis of gamma ray induced contamination of neutron dosimetry procedures used for reactor pressure vessel applications. Final report.** Simmons, G.L. (Science Applications, Inc., La Jolla, CA (USA)). Apr 1979. 59p. Dep. NTIS, PC A03/MF A01.

Science Applications, Incorporated (SAI) has performed measurements and calculations to assess the effect of photon induced activity in neutron spectra measuremes for pressure vessel dosimetry. Such measurement contamination would lead to an overestimate of the neutron flux incident on the pressure vessel, and, hence, an underestimate of the pressure vessel lifetime. Measurements were performed using the pool-type reactor at the University of Virginia at Charlottesville (UVA). Threshold dosimetry foils were used in conjunction with a photofraction gauge to measure neutron spectra and the fraction of activity in the foils due to gamma rays at various distances from the core. One-dimensional calculations were performed to theoretically predict the measured data and good agreement was found. Several methods for correcting measured neutron spectra for photocontamination are presented and applied to UVA reactor measurements.

44754 (NUREG/CR—0715) **In-plant source term measurements at Zion Station.** Dyer, N.C.; Bunting, R.L.; Croney, S.T. (Idaho National Engineering Lab., Idaho Falls (USA); Allied Chemical Corp., Idaho Falls, ID (USA)). Feb 1979. 399p. NTIS, PC A18/MFA01.

Data are presented which were obtained at Zion Station for an in-plant source term measurement program in operating pressurized water reactors (PWR's). The objective of this program is to provide operational data that can be used by the NRC in the generic evaluation of plant system design in the licensing process and for updating of the calculational model used by the NRC staff in their evaluation of radioactive waste management systems for operating PWR's. A data base is provided for radioisotope inventory in plant systems, radioactive waste management system performance, and source terms for both liquid and gaseous systems.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

44755 (GA-A—14704) **Residual stress, strain, and strength measurements in Peach Bottom fuel test elements.** Wallroth, C.F.; Miller, C.M.; Saurwein, J.J. (General Atomic Co., San Diego, CA (USA)). May 1979. Contract EY-76-C-03-0167-065. 21p. (CONF-790802—37). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

An experimental program measuring residual stress, strain, and strength distributions in H-327 graphite teledial fuel bodies irradiated to fast neutron fluences up to 4.2×10^{25} n/m^2 (E > 29 fJ)/ sub HTGR/ in the Peach Bottom High-Temperature Gas-Cooled Reactor has been completed. The techniques employed included dimensional change measurements on intact fuel bodies, pressure bursting of fuel holes, diametral compression tests, ring cutting, strip cutting, and four-point bend tests. In all, 3500 tests were performed, 2200 of which were on irradiated material. The results obtained from irradiated samples were compared with measurements on unirradiated control specimens to estimate irradiation-induced changes in material properties. Irradiation conditions were obtained from computer simulation of the reactor operating history and have been verified by gamma spectroscopy and in-pile thermocouple readings. Experimental results were compared with analytical predictions, when available.

44756 (NUREG/CR—0776) **DASH: a multicomponent time-dependent concentration diffusion with radioactive decay program.** Apperson, C.E. Jr.; Lee, C.E.; Carruthers, L.M. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-31-109-ENG-36. 96p. (LA—7793-MS). Dep. NTIS, PC A05/MF A01.

The multicomponent time-dependent diffusion with radioactive decay problem which arises in the study of high-temperature gas-cooled reactors fission product migration is solved in one-dimensional geometries. The spatial multicomponent diffusion operator is numerically represented by a conservative finite difference approximation. An analytic time-dependent solution is achieved using a matrix operator method. Comparisons of the analytic-numerical solution method with a variety of analytic solutions give excellent agreement. This solution technique has been incorporated into an algorithm for use in a computer code, DASH. The holdup of ^{90}Sr by graphite is calculated.

44757 **Process for the production of block fuel elements for high temperature reactors.** Hrovat, M.; Rachor, L. (to Hochtemperaturreaktor-Brennelement GmbH). US Patent 4,140,738. 20 Feb 1979. Priority date 8 Mar 1976, German, Federal Republic of (F.R. Germany), 6p.

There is provided a process for the production of block fuel elements for gas cooled high temperature reactors by multiple step molding of a granulated graphite material comprising a mixture of natural graphite powder, synthetic graphite powder and binder resin together with coated fissile and fertile fuel particles using a lubricant and a hydrocarbon, alcohol, phenol, amine, aldehyde, ketone or ether as an air displacing agent whereby the outer form and the cooling gas channels are produced by molding and the molding temperature in the last molding step is above the softening point of the binder resin and wherein the binder resin is so chosen that it has a softening point at least 15°C above the melting point of the lubricant used and the block is ejected from the die in the temperature interval between the melting point of the lubricant and the softening point of the binder resin.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 44832, 44833, 44834, 44846, 44857, 44860, 44861, 44865, 45680

44758 (BNL-NUREG—25498) **Single-phase sodium pump model for LMFBR thermal-hydraulic analysis.** Madni, I.K.; Cazzoli, E.G.; Agrawal, A.K. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 28p. (CONF-790816—10). Dep. NTIS, PC A03/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A single-phase, homologous pump model has been developed for simulation of safety-related transients in LMFBR systems. Pump characteristics are modeled by homologous head and torque relations encompassing all regimes of operation. These relations were derived from independent model test results with a centrifugal pump of specific speed equal to 35 (SI units) or 1800 (gpm units), and are used to analyze the steady-state and transient behavior of sodium pumps in a number of LMFBR plants. Characteristic coefficients for the polynomials in all operational regimes are provided in a tabular form. The speed and flow dependence of head is included through solutions of the impeller and coolant dynamic equations. Results show the model to yield excellent agreement with experimental data in sodium for the FFTF prototype pump, and with vendor calculations for the CRBR pump. A sample pipe rupture calculation is also performed to demonstrate the necessity for modeling the complete pump characteristics.

44759 (CONF-790306—18) **Cesium chemistry in GCFR fuel pins.** Fee, D.C.; Johnson, C.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The fuel rod design for the Gas Cooled Fast-Breeder Reactor (GCFR) is similar to that employed for the Liquid Metal Fast Breeder Reactor (LMFBR) with the exception of the unique features inherent to the use of helium as the coolant. These unique design features include the use of (1) vented and pressure-equalized fuel rods, and (2) ribbed cladding along 75% of the fuel section. The former design feature enables reduction in cladding thickness and prevention of possible creep collapse of the cladding due to the high coolant pressure (8.5 MPa). The latter design feature brings about improved heat transfer characteristics. Each GCFR fuel rod is vented to a manifold whereby gaseous fission products diffusing out of the fuel pin are retained on charcoal traps. As a result, the internal pressure of a GCFR fuel pin does not increase during irradiation. In addition, the venting system also maintains the pressure within the fuel pin slightly below (0.3 to 0.5 MPa) the coolant pressure outside the fuel pin. Consequently, should a breach occur in the cladding, helium flows into the breached fuel pin thereby minimizing fission product contamination of the coolant. These desirable aspects of a GCFR fuel pin can be maintained only as long as axial gas transport paths are available and operating within the fuel pin.

44760 (CONF-790402—20) **Application of an LP model to breeder strategy studies.** Till, C.E.; Chang, Y.I. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From Computational methods in nuclear engineering; Williamsburg, VA, USA (23 Apr 1979).

The paper discusses the relationships between the capital cost differential (FBR—LWR) allowable for economic breeder introduction and energy demand, resource availability (through price—quantity schedule), and economic environment for a range of future projections. The ALPS linear programming reactor systems analysis code, developed by Hanford Engineering Development Laboratory, was used for economic optimizations where they were done, and where they were not it provided a useful tool to compute the discounted total system power cost over the planning horizon for a given set of reactor mix and cost parameters.

44761 (CONF-790615—13) **Evaluation of the influence of seismic restraint characteristics on breeder reactor piping systems.** Mello, R.M.; Pollono, L.P. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1979. Contract EW-76-C-15-2395. 19p. Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

For the Clinch River Breeder Reactor Plant (CRBRP) heat transport system piping within the reactor containment building, dynamic analyses of the piping loops have been performed to study the effect of restraint stiffness on the dynamic behavior of the piping. In addition, analysis and testing of typical CRBRP restraint system components have been performed for the purpose of quantifying and verifying the basic characteristics of the restraints used in the piping system dynamic analysis.

44762 (COO—2245-62TR) **Laboratory manual for salt mixing test in rod bundles.** Khan, H.U.R.; Chiu, C.; Todreas, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Oct 1978. Contract-EY-76-S-02-2245. 37p. Dep. NTIS, PC A03/MF A01.

This report is a Laboratory Manual dealing with the procedure employed during Salt Tracer Experiments, which are used for evaluating the hydraulic characteristics of a rod bundle. A description of the standard equipment used is given together with details of manufacture of non-standard items i.e., probes used for detecting the salt-concentration. Details of bundle construction have not been included as they are available in the references cited. An attempt has also been made to point out potential trouble areas and procedures.

44763 (COO—2458-23) **Analysis of exposure dependent heterogeneous FBR spectra using continuous slowing down-integral transport concepts.** Badruzzaman, A.; Badruzzaman, T.; Becker, M. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering). 1979. Contract EY-76-S-02-2458. 7p. (CONF-790602—44). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Generalized continuous slowing down (CSD) theory coupled with integral transport concepts has been shown to give accurate prediction of the spatial variation of exposure dependent spectra at the core-blanket interface and in the blanket region of the homogeneous design fast reactor. The spectrum and the spectrum-averaged cross sections (SAXS) exhibited a strong space dependence as one proceeded from the outer core into the blanket. However, at any given location these varied rather weakly with exposure. In the paper the authors have extended the procedure to analyse the heterogeneous LMFBR spectra with depletion. Briefly, one solves a matrix differential equation of the zonal slowing down densities; the equation being a generalization of slowing down equations of the Greuling—Goertzel type with a source term. One then uses a multiregion analogue of the usual expressions of flux in terms of slowing down densities, either of the Greuling—Goertzel or Wigner form. The formalism has been applied to an infinite array of alternating core and blanket zones in slab geometry. The properties of these zones are based on Clinch River Breeder Reactor (CRBR) parameters and calculations were performed with the 29 group FTR-300 data set.

44764 (GA-A—15300) **Gas-cooled fast breeder reactor. Updated design for a helium circulator test facility.** (General Atomic Co., San Diego, CA (USA)). Apr 1979. Contract EY-76-C-03-0167-023. 244p. Dep. NTIS, PC A11/MF A01.

The Gas-Cooled Fast Breeder Reactor (GCFR) Demonstration Plant uses three helium loops to transfer heat from the reactor core to the steam generators. Helium flow in each loop is provided by a circulator driven by a 24,000 horsepower electric motor. Experimental verification of the designs of the circulator, circulator service system, main and pony motors, main and pony motor controllers, loop isolation valve instrumentation and control systems is needed to demonstrate that operational and safety requirements are met. A GCFR helium circulator test facility sized for full design conditions is proposed. The circulator will be mounted in a large vessel containing high pressure helium which will permit testing at the same power, speed, pressure, temperature and flow conditions present in the (demonstration) plant. The electric drive motor for the circulator will obtain its power from an electrical supply and distribution system in which electrical power will be taken from a local utility grid via a transformer.

44765 (GA-A—15367) **Stoichiometry effects on GCFR mixed oxide fuel behavior.** Lindgren, J.R.; Langer, S.; Buzzelli, G.; Acharya, R.; Flynn, P.W.; Greenberg, S.; Johnson, D.; Longest, A.W. Jr. (General Atomic Co., San Diego, CA (USA)). May 1979. Contract EY-76-C-03-0824-001. 24p. (CONF-790602—66). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The fuel rods in the gas-cooled fast breeder reactor (GCFR) are vented. Thermal flux irradiation tests with vented pressure-equalized rods and fast flux irradiations with simulated vented rods have been or are being performed. These irradiations have used mixed oxide fuel pellets containing 15% to 25% PuO_2, with oxygen/metal (O/M) ratios ranging from 1.95 to 1.99, and clad with 20% cold-worked 316 stainless steel. Both sol-gel-derived and mechanically blended fuels have been or are being tested. The results of PIE gamma spectrometry and destructive examination of GCFR fuel rods indicate the following: (1) Cladding attack and diametral changes were minimal for a rod with a fuel O/M ratio of 1.95. However, for rods with a fuel O/M ratio of 1.98, the attack ranged from 0 to ~ 100 μm and diametral changes were 0.2% to 0.9% ΔD/D. (2) Cs-137 transport is promoted by low O/M fuel. Cs-133 was released and transported principally as its precursor Xe-133. After deposition in the rod and decay to Cs-133, it was permanently retained at that location. Cs-134, an activation product of Cs-133, serves as a monitor of the behavior of the 133 mass chain. However, release of Xe-133 should not be related to the O/M of the fuel.

44766 (GEFR—10028-68) **Core engineering. Sixty-eighth quarterly report, August—October 1978.** (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Nov 1978. Contract EY-76-C-03-0893-031. 47p. AT.

Progress is summarized in LMFBR fuel assembly engineering and core component design analysis.

44767 (GEFR—14031-17) **Core restraint engineering. Seventeenth quarterly report, August—October 1978.** (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Nov 1978. Contract EY-76-C-03-0893-031. 37p. AT.

The overall objective of the program is to develop, in conjunction with other members of the National Core Mechanics nd Configuration Performance Program, the design guidelines and the corresponding technology required to design LMFBR core restraint systems and to support applicable licensing processes.

44768 (HEDL-SA—1724) **Quality assurance for breeder reactor fuel fabrication.** Marx, E.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 29 Dec 1978. Contract EY-76-C-14-2170. 24p. (CONF-790420—12). Dep. NTIS, PC A02/MF A01.

From International symposium on ceramics in nuclear waste management; Cincinnati, OH, USA (30 Apr 1979).

Fuel performance in the Fast Flux Test Facility (FFTF) depends on fabrication of fuel to rigorous quality standards. The quality program including Management, Procurement, Fabrication, Inspection, Records, and Audits is discussed as well as unique mixed oxide fuel inspections such as homogeneity inspection, analytical chemistry, and nondestructive fissile assay.

44769 (KFK—2387(Pt.7)) **KEDAK program compendium. Part VII: CALCUL-calculation.** Langner, I.; Meyer, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1977. 121p. Dep. NTIS (US Sales Only), PC A06/MF A01.

Work performed under United States—West Germany Fast Reactor Exchange Program.

CALCUL is a program system to calculate composed cross section quantities and to arrange them according to KEDAK-conventions. A special command language has been generated to simplify the input and to provide interactive communication under time-sharing-option. In CALCUL any amount of data can be processed. The output of the program is a data set which can be directly used as an input to program system KEMA which modifies the KEDAK-library.

44770 (ORNL/TM—6679) **Ultrasonic evaluation of dissimilar-metal transition joint welds.** Smith, J.H. (Oak Ridge National Lab., TN (USA)). Apr 1977. Contract W-7405-ENG-26. 48p. AT.

Ultrasonic techniques for the nondestructive examination of the dissimilar-metal transition joints designed for the Clinch River Breeder Reactor were studied. This included determining the acoustical properties of the various materials involved and evaluating the relative merits of several examination techniques and associated parameters. Using the results of these studies, ultrasonic inspection methods that can be used to evaluate 12.7- and 25.4-mm-thick dissimilar-metal welds in transition joints in the as-manufactured (machined) condition were developed. A 2:1 signal-to-noise ratio notches whose depths are 8% of the weld thickness at any of the four weld root interfaces and in the weld root volume of both welds can be detected. Better sensitivity can be obtained if multiple test frequencies are used and if only the root areas of the welds and weld interfaces are considered.

44771 (PNL—2923) **COBRA-IV comparison with the WARD 11:1 scale LMFBR air flow tests.** Basehore, K.L.; George, T.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 61p. Dep. NTIS, PC A04/MF A01.

The COBRA-IV code was verified against the results of the Westinghouse Advanced Reactor Division (WARD) 11:1 scale liquid metal fast breeder reactor (LMFBR) fuel assembly air flow tests. The major effort in comparing COBRA results with the data was directed toward matching the transverse velocities, though axial velocity comparisons were also made. Four input parameters to the COBRA code are known to have a significant effect on the velocity distribution within a wirewrapped LMFBR bundle. The relevant parameters are: the turbulent mixing coefficient, the turbulent cross-flow resistance factor, the effective pitch length for forcing cross-flow and the transverse momentum geometry factor. Computational results for various values of each of these input quantities are presented for the transverse velocity component of the flow field. Axial velocity comparisons are also made using the calibrated set of parameters.

44772 **Nuclear design and economic comparison of a conventional and bullseye liquid-metal fast breeder reactor core.** Vitti, J.A.; Felten, L.D.; Galluzzo, N.G.; Otter, J.M.; Brittingham, J.C. (Atomics International Div., Canoga Park, CA). *Nucl. Technol.;* **44**: No. 1, 10-20(Jun 1979).

Reactor system design and safety studies at Atomics International have focused on the selection of a core configuration for the Prototype Large Breeder Reactor that has inherent nonenergetic responses to postulated core disruptive accidents. These studies have led to the selection of a non-conventional heterogeneous design, referred to as the bullseye core, as the preferred concept. The nuclear design characteristics and economics of this bullseye core are compared to those of an optimized, conventional liquid—metal fast breeder reactor core configuration, referred to as the regular core. A reduced sodium void worth and an enhanced voiding incoherence are attained by the introduction of internal blanket regions in the bullseye core. The bullseye core total energy costs are shown to be acceptable considering the significant improvement in licensability due to reduced core energetics.

44773 **Physics studies of a heterogeneous liquid—metal fast breeder reactor.** Lineberry, M.J.; McFarlane, H.F.; Collins, P.J.; Carpenter, S.G. (Argonne National Lab., Idaho Falls, ID). *Nucl. Technol.;* **44**: No. 1, 21-43(Jun 1979).

The first physics measurements for a heterogeneous design of a 1000-MW (thermal) liquid—metal fast breeder reactor were made in the Zero Power Plutonium Reactor (ZPPR) during the last half of 1976. This benchmark assembly, ZPPR-7, had a central blanket zone as well as three internal blanket rings. Fuel zones had a single enrichment. Cores with heavy plutonium buildup in the internal blankets as well as cores with clean internal blankets were investigated. Such key physics parameters as k/sub eff/, most of the important reaction rates, control rod worths, sodium void reactivity, and material worths were studied in the ZPPR-7 program. Results verified the gain in breeding that were predicted for the heterogeneous arrangement. When design-level calculations were used, calculated-to-experimental biases were different from those that had been found for homogeneous cores.

44774 **Performance characteristics of homogeneous versus heterogeneous liquid—metal fast breeder reactors.** Barthold, W.P.; Beitel, J.C. (Argonne National Lab., IL). *Nucl. Technol.;* **44**: No. 1, 44-60(Jun 1979).

Six homogeneous and heterogeneous core configurations with different fuel pin diameters and different degrees of neutronic coupling have been analyzed. All designs were based on the same design assumptions and constraints. Homogeneous and heterogeneous designs were evaluated with respect to fissile inventory, flux and power distribution, burnup, breeding ratio and doubling times, sodium void reactivity, Doppler coefficient, control rod worth, and transient response. The sensitivity of breeding performance to different fuel life criteria was determined.

44775 **Nuclear performance of liquid—metal fast breeder reactors designed to preclude energetic hypothetical core disruptive accidents.** Bailey, H.S.; Lu, Y.S. (General Electric Co., Sunnyvale, CA). *Nucl. Technol.;* **44**: No. 1, 76-82(Jun 1979).

A study of various core designs was conducted to investigate design features pertaining to the preclusion of energetic hypothetical core disruptive accidents. The design data and core layouts for different designs are described. A summary of the nuclear performance predicted for several typical low sodium void worth cores is presented. It appears that the tightly coupled heterogeneous core configuration offers a substantial reduction in prompt void worth and flux level at the expense of greater inventory, large flux gradients, and large changes in internal blanket power over the operating cycle.

44776 **Multiaxial creep equations for nonlinear and volume-nonconservative in-reactor creep.** Hall, M.M. Jr. (Argonne National Lab., IL). *Nucl. Technol.;* **44**: No. 1, 172-176(Jun 1979).

Steady-state multiaxial creep equations that may be applied to the analysis of nonlinear and volume-nonconservative in-reactor creep data have been derived. Strain rate equations are expressed in terms of the stress exponent, n, a rate constant, B, and a material parameter, β. Equivalent stress states are assumed to give equal mechanical energy dissipation rates, and the associated equivalent stress and plastic strain rate criteria are shown to be functions of both the shear and hydrostatic components of the stress and strain-rate tensors, respectively. The deviatoric creep rate coefficient is shown to be an apparent function of stress state when swelling is stress dependent and the stress exponent is greater than unity. The possible magnitude of this stress-state effect is estimated for fast-neutron-irradiated austenitic stainless steel using available microstructural models.

44777 Nuclear instrumentation cable end seal. Cannon, C.P.; Brown, D.P. (to Dept. of Energy). US Patent 4,137,423. 30 Jan 1979. Filed date 16 Dec 1977. 6p.
PAT-APPL-861,132.

An improved coaxial end seal for hermetically sealed nuclear instrumentation cable exhibiting an improved breakdown pulse noise characteristic under high voltage, high temperature conditions is described. A tubular insulator body has metallized interior and exterior surface portions which are braze sealed to a center conductor and an outer conductive sheath. The end surface of the insulator body which is directed toward the coaxial cable to which it is sealed has a recessed surface portion within which the braze seal material terminates.

44778 Technique for detecting liquid metal leaks. Bauerle, J.E. (to Dept. of Energy). US Patent 4,134,290. 16 Jan 1979. Filed date 6 Sep 1977. 4p.
PAT-APPL-830,948.

In a system employing flowing liquid metal as a heat transfer medium in contact with tubular members containing a working fluid, i.e., steam, liquid metal leaks through the wall of the tubular member are detected by dislodging the liquid metal compounds forming in the tubular member at the leak locations and subsequently transporting the dislodged compound in the form of an aerosol to a detector responsive to the liquid metal compound. In the application to a sodium cooled tubular member, the detector would consist of a sodium responsive device, such as a sodium ion detector.

44779 Pipe support. Pollono, L.P. (to Dept. of Energy). US Patent 4,134,563. 16 Jan 1979. Filed date 28 Jan 1976. 4p.
PAT-APPL-653,044.

A pipe support for high temperature, thin-walled piping runs such as those used in nuclear systems is described. A section of the pipe to be suppported is encircled by a tubular inner member comprised of two walls with an annular space therebetween. Compacted load-bearing thermal insulation is encapsulated within the annular space, and the inner member is clamped to the pipe by a constant clamping force split-ring clamp. The clamp may be connected to pipe hangers which provide desired support for the pipe.

44780 Temperature-dependent liquid metal flowrate control device. Carlson, R.D. (to Dept. of Energy). US Patent 4,125,221. 14 Nov 1978. Filed date 7 Sep 1977. 4p.
PAT-APPL-831,193.

A temperature-dependent liquid metal flowrate control device includes a magnet and a ferromagnetic member defining therebetween a flow path for liquid metal, the ferromagnetic member being formed of a material having a curie temperature at which a change in the flow rate of the liquid metal is desired. According to the preferred embodiment the magnet is a cylindrical rod magnet axially disposed within a cylindrical member formed of a curie material and having iron pole pieces at the ends. A cylindrical iron shunt and a thin wall stainless steel barrier are disposed in the annulus between magnet and curie material. Below the curie temperature flow between steel barrier and curie material is impeded and above the curie temperature flow impedance is reduced.

44781 Ultrasonic dip seal maintenance system. Poindexter, A.M.; Ricks, H.E. (to Dept. of Energy). US Patent 4,116,766. 26 Sep 1978. Filed date 31 Aug 1976. 10p.
PAT-APPL-719,310.

Disclosed is a system for removing impurities from the surfaces of liquid dip seals and for wetting the metal surfaces of liquid dip seals in nuclear components. The system comprises an ultrasonic transducer that transmits ultrasonic vibrations along an ultrasonic probe to the metal and liquid surfaces of the dip seal thereby loosening and removing those impurities.

44782 Nuclear reactor pressure vessel support system. Sepelak, G.R. (to Dept. of Energy). US Patent 4,115,193. 19 Sep 1978. Filed date 17 Aug 1976. 10p.
PAT-APPL-715,255.

Disclosed is a support system for nuclear reactor pressure vessels which can withstand all possible combinations of stresses caused by a postulated core disrupting accident during reactor operation. The nuclear reactor pressure vessel is provided with a flange around the upper periphery thereof, and the flange includes an annular vertical extension formed integral therewith. A support ring is positioned atop of the support ledge and the flange vertical extension, and is bolted to both members. The plug riser is secured to the flange vertical extension and to the top of a radially outwardly extension of the rotatable plug. This system eliminates one joint through which fluids contained in the vessel could escape by making the fluid flow path through the joint between the flange and the support ring follow the same path through which fluid could escape through the plug risers. In this manner, the sealing means to prohibit the escape of contained fluids through the plug risers can also prohibit the escape of contained fluid through the securing joint.

44783 Core disruptive accident margin seal. Garin, J.; Belsick, J.C. (to Dept. of Energy). US Patent 4,113,564. 12 Sep 1978. Filed date 13 Aug 1976. 8p.
PAT-APPL-714,220.

Disclosed is an apparatus for sealing the annulus defined between a substantially cylindrical rotatable first riser assembly and plug combination disposed in a substantially cylindrical second riser assembly and plug combination of a nuclear reactor system. The apparatus comprises a flexible member disposed between the first and second riser components and attached to a metal member which is attached to an actuating mechanism. When the actuating mechanism is not actuated, the flexible member does not contact the riser components thus allowing the free rotation of the riser components. When desired, the actuating mechanism causes the flexible member to contact the first and second riser components in a manner to block the annulus defined between the riser components, thereby sealing the annulus between the riser components.

44784 Apparatus for controlling coolant level in a liquid-metal-cooled nuclear reactor. Jones, R.D. (to Dept. of Energy). US Patent 4,113,562. 12 Sep 1978. Filed date 20 Apr 1977. 6p.
PAT-APPL-789,154.

A liquid-metal-cooled fast-breeder reactor which has a thermal liner spaced inwardly of the pressure vessel and includes means for passing bypass coolant through the annulus between the thermal liner and the pressure vessel to insulate the pressure vessel from hot outlet coolant includes control ports in the thermal liner a short distance below the normal operating coolant level in the reactor and an overflow nozzle in the pressure vessel below the control ports connected to an overflow line including a portion at an elevation such that overflow coolant flow is established when the coolant level in the reactor is above the top of the coolant ports. When no makeup coolant is added, bypass flow is inwardly through the control ports and there is no overflow; when makeup coolant is being added, coolant flow through the overflow line will maintain the coolant level.

44785 Packed rod neutron shield for fast nuclear reactors. Eck, J.E.; Kasberg, A.H. (to Dept. of Energy). US Patent 4,111,747. 5 Sep 1978. Filed date 8 Jun 1976. 8p.
PAT-APPL-693,990.

Disclosed is a fast neutron nuclear reactor including a core and a plurality of vertically oriented neutron shield assemblies surrounding the core. Each assembly includes closely packed cylindrical rods within a polygonal metallic duct. The shield assemblies are less susceptible to thermal stresses and are less massive than solid shield assemblies, and are cooled by liquid coolant flow through interstices among the rods and duct.

44786 Self locking drive system for rotating plug of a nuclear reactor. Brubaker, J.E. (to Dept. of Energy). US Patent Application 880,679. 23 Feb 1978. 13p.

The disclosure describes a self-locking drive system for rotating the plugs on the head of a nuclear reactor which is able to restrain plug motion if a seismic event should occur during reactor refueling. A servomotor is engaged via a gear train and a bull gear to the plug. Connected to the gear train is a feedback control system which allows the motor to rotate the plug to predetermined locations for refueling of the reactor. The gear train contains a self locking double enveloping worm gear set. The worm gear set is utilized for its self locking nature to prevent unwanted rotation of the plugs as the result of an earthquake. The double enveloping type is used because its unique contour spreads the load across several teeth providing added strength and allowing the use of a conventional size worm.

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

44787 (LA—7821-MS) **Conceptual designs for two reject heat systems for a Brayton closed-cycle converter.** Bennett, G.A. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 34p. Dep. NTIS, PC A03/MF A01.

Designs for two candidate reject heat systems (RHS) have been developed for a Brayton closed-cycle space nuclear power system. The most important constraints imposed on the design are the size and mass limits and the rigid survival standard of 99% probability that the RHS be functional at full power at the end of a seven-year mission. The two basic design concepts developed are (1) a secondary loop RHS with a redundant heat exchanger and (2) a direct-pumped gas RHS. Both concepts make extensive use of heat pipes to provide redundancy. The secondary loop design includes a pumped-NaK radiator and a heat-pipe heat exchanger. The radiator is of conventional design with armored flow tube passages and fins arranged in rectangular panels placed at right angles to each other. The heat exchanger is a cylindrical pressure vessel with four radiator loops and two converter loops. The direct-pumped gas RHS is designed with many thin-walled, finned heat pipes placed side by side to form rectangular radiator panels that are arranged at right angles to each other. The gas heat exchanger is an armored manifold composed of multiple parallel flow tubes placed at the evaporator end of the radiator heat pipes. Results show that this system is the lightest configuration investigated.

44788 (LA-UR—79-1242) **Baseline design of the thermoelectric reactor space power system.** Ranken, W.A.; Koenig, D.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790803—21). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

An extensive review of design alternatives for a nuclear reactor space power system capable of delivering 10 to 100 kW/sub e/ has led to the selection of a heat-pipe-cooled fast spectrum reactor with a thermoelectric power conversion system. The reactor design features a laminated core configuration with sheets of molybdenum - extending across the full diameter of the core - interspersed between layers of UO_2. Reactor heat is transferred by these sheets from the UO_2 to an array of 90 Mo/Na heat pipes that are spaced so that each receives equal power from an essentially uniform fuel loading in the core. This heat is transported by these heat pipes around the LiH shield to a ring of high-power-density thermoelectric modules constructed from modified SiGe alloys. Conversion takes place over a temperature interval of 1375 to 775 K with an efficiency of 9%. Residual heat is rejected by a conical radiator that is constructed from cross-coupled beryllium heat pipes. The discussion of this system will emphasize manifestations of the overriding design consideration - that of avoiding both single point failure and propagating failure chains. A technology readiness program has been initiated to demonstrate that key components of the reactor/thermoelectric power system can be constructed to meet performance objectives for the required seven year lifetime. These components include the fuel configuration, the core, radiator and cross-coupling heat pipes, the thermoelectric modules and the shield, reflector, and control assemblies. This problem is described and key results are discussed.

44789 (N—78-29118) **A critical review of the state of foreign space technology.** Grey, J.; Gerard, M. (American Inst. of Aeronautics and Astronautics, New York). 28 Feb 1978. Contract NASW-3098. 72p. NTIS PC A04/MF A01.

A conference was held to exchange technical information in the area of space technology. Soviet system capability and technology both in Intersputnik and in the domestic Ekran system was discussed in detail. The thermionic power conversion system used in the Soviet Topaz nuclear power reactor was described in detail. Other areas of examination included: (1) Bioastronautics; (2) Space based industry; (3) Propulsion; (4) Astrodynamics; (5) Contact with extraterrestrial intelligence; and (6) Space rescue and safety.

44790 **Compact power reactor.** Wetch, J.R.; Dieckamp, H.M.; Wilson, L.A. (to Dept. of Energy). US Patent 4,127,443. 28 Nov 1978. Filed date 4 May 1960. 14p.

PAT-APPL-26,904.

There is disclosed a small compact nuclear reactor operating in the epithermal neutron energy range for supplying power at remote locations, as for a satellite. The core contains fuel moderator elements of Zr hydride with 7 w/o of 93% enriched uranium alloy. The core has a radial beryllium reflector and is cooled by liquid metal coolant such as NaK. The reactor is controlled and shut down by moving portions of the reflector.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 44795

44791 (NTISUB/B/201—002-R5) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1978. 40p. NTIS PC A03.

Revision No. 1 to Section 2 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

44792 (NTISUB/B/201—002-R6) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1978. 16p. NTIS PC A02.

Revision No. 1 to Section 2 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

44793 (NTISUB/B/201—015-R6) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 15.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1978. 13p. NTIS PC A02.

Revision No. 1 to Section 15 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

44794 (RDT-STATUS—(4-79)) **RDT Standards status report, April 1979.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). 1979. Contract W-7405-ENG-26. 39p. Free from RSO.

The April 1979 Status Report of RDT Standards covering the period of January through March 1979 is presented.

REACTOR DOCKETS

44795 (NUREG—0540(Vol.1)(No.3)) **Title list of documents made publicly available, March 1—31, 1979.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). 1979. 379p. NTIS, PC A17/MF A01.

The Docketed Items list is arranged sequentially, first by Docket Number and then by Accession Number. The Nondocketed Items list is arranged sequentially by Accession Number. Personal author, corporate source, and report number indexes are provided. (RWR)

ECONOMICS

FUEL CYCLE

44796 (EPA—520/6-78-008) **Thorium fuel-cycle alternatives.** Pigford, T.H.; Yang, C.S. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering). Nov 1978. 168p. (UCB-NE—3227). Dep. NTIS, PC A08/MF A01.

Actinide material quantities and lifetime uranium ore requirements are calculated for thorium fuel cycles in pressurized-water reactors, high-temperature gas-cooled reactors, and pressure-tube heavy-water reactors, and are compared with similar quantities for reference uranium—plutonium fueling in light-water reactors and in fast breeders. Flowsheets are presented for national—international fuel cycles for safeguard controls, including dispersed national reactors fueled with thorium and denatured uranium. Long-term radioactivity properties of high-level radioactive wastes are compared. Also compared are the production of ^{14}C, ^{3}H, ^{232}U, and other activated radionuclides from these reactors and fuel cycles.

44797 (MIT-EL—79-003) **Nuclear fuel assurance: origins, trends, and policy issues.** Neff, T.L.; Jacoby, H.D. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Feb 1979. Contract EX-76-A-01-2295. 140p. Dep. NTIS, PC A07/MF A01.

The economic, technical and political issues which bear on the security of nuclear fuel supply internationally are addressed. The structure of international markets for nuclear fuel is delineated; this includes an analysis of the political constraints on fuel availability, especially the connection to supplier nonproliferation policies. The historical development of nuclear fuel assurance problems is ex-

plored and an assessment is made of future trends in supply and demand and in the political context in which fuel trade will take place in the future. Finally, key events and policies which will affect future assurance are identified.

44798 (ORNL/TM—6504) **Research and development requirements for the recycle of bred fuels in uranium and thorium fuel cells.** Kasten, P.R.; Wymer, R.G.; Burch, W.D.; Vondra, B.L.; Lotts, A.L.; Olsen, A.R.; Carter, W.L.; Rainey, R.H.; Johnson, D.R. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 55p. Dep. NTIS, PC A04/MF A01.

A summary is given of the 1978 status of fuel recycle technology, along with the research and development (R & D) which is required prior to commercialization of fuel recycle. The fuel cycles consider use of uranium, thorium, or mixed uranium—thorium-based fuels; the reactor types include Light Water Reactors (LWRs), Spectral Shift Controlled Reactors (SSCRs), Heavy Water Reactors (HWRs), High-Temperature Gas-Cooled Reactors (HTGRs), Liquid Metal Fast Breeder Reactors (LMFBRs), and Gas-Cooled Fast Reactors (GCFRs). Estimates of the schedules and costs for implementing the various fuel cycles in the different reactor types are given, and include those for demonstration/pilot plants. The technical areas cover fuel fabrication/refabrication, fuel reprocessing, fuel qualification, and waste treatment.

PROCESS HEAT REACTORS

44799 (LA-UR—79-520) **Hydroelastic phenomena in boiling water reactor suppression pools.** Nichols, B.D.; Hirt, C.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790802—26). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

In a postulated loss-of-coolant accident (LOCA) in a boiling water reactor (BWR) air is initially forced through vents into large water pools designed for steam pressure suppression. This air injection may induce a variety of hydrodynamic loads on the suppression pool and its internal structures. A new multidimensional, finite-difference method, SOLA-VOF, is applied to obtain an understanding of the basic fluid dynamics associated with the vent clearing process. Calculations are presented and compared with data obtained in two small scale laboratory test programs designed to model aspects of the G.E. MARK I and MARK II pressure suppression systems.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 45661

44800 (BNL—50976) **Fast-mixed spectrum reactor interim report initial feasibility study.** Fischer, G.J.; Cerbone, R.J. (Brookhaven National Lab., Upton, NY (USA); Argonne National Lab., IL (USA)). Jan 1979. Contract EY-76-C-02-0016. 201p. Dep. NTIS, PC A10/MF A01.

The report summarizes the results of an initial four-month feasibility study of the Fast-Mixed Spectrum Reactor (FMSR). Reactor physics, fuel cycle, and thermal-hydraulic analyses were performed on a reference design. These results when coupled to a fuel and materials evaluation performed in cooperation with the Argonne National Laboratory indicate that the FMSR is feasible provided the fuels, cladding, and subassembly ducts can survive a peak fuel burnup of 15 to 20 atom percent heavy metal and peak fluences of 8×10^{23} (nvt > 0.1 MeV). The results of this short study have also provided a basis for exploring alternative designs requiring significantly lower peak burnup and fluences for their operation.

44801 (LA—7767-PR) **Reactor technology. Progress report, October—December 1978.** Emigh, C.R.; Breslow, M. (eds.). (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 116p. Dep. NTIS, PC A06/MF A01.

The Nuclear Space Electric Power Supply (SEPS) Program has been renamed Space Reactor Technology Program (SPAR). The first phase of the SPAR program, the screening studies, has been completed, yielding the following experimental design: a reactor with UO_2—20 vol% Mo fuel and sodium—molybdenum heat pipes; radiator attenuation shield design using LiH; electrical conversion using silicon—germanium alloyed with gallium phosphide thermoelectrics; and a heat-pipe radiator designed to reject heat at 775 K. Technical feasibility studies based on these recommendations have begun. Neutron transfer calculations have confirmed the proposed critical configurations for the SPAR reactor. The SPAR radiation shielding is being investigated using Monte Carlo three-dimensional calculations. Activities in the Reactor Structural Investigations Program have continued to focus on seismic modeling and PCRV analysis. The last in a series of tests of one-dimensional models investigating the effect of Coulomb friction on system response has been completed. A β-SiC heat pipe with a layer of tungsten on the inner wall was successfully tested. The Nuclear Criticality Operations and Safety Program continues studies of the possible use of Godiva neutron bursts to measure the subcritical multiplication of dynamic assembly of fissionable material at the PHERMEX facility. An experiment is being prepared to measure the efficiency of conversion ofthe kinetic energy from fission fragments into energy contained in the excited electron states of rare gas molecules; a determination vital to the Nuclear Pumped Laser Program. With the demise of plans to build the Fast Reactor Safety Test Facility, work with the PARKA critical assembly is now directed toward the verification of SIMMER code calculations.

44802 (PNL—2917) **Sources of neutronics data involving thorium of ^{233}U and light water moderation.** Davenport, L.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1978. Contract EY-76-C-06-1830. 56p. Dep. NTIS, PC A04/MF A01.

A literature search has been conducted to locate sources of neutronics data for light water moderated systems which contain thorium and/or uranium-233. It is concluded that insufficient data is currently available to validate neutronics design methods for licensing the $^{233}UO_2$-ThO_2 fuel cycle in light water reactors. A summary of the neutronics data sources found is reported in this document. These sources include critical and exponential experiments with lattices of fuel rods containing ^{233}U + Th or ^{235}U + Th. A few experiments using homogeneous aqueous solutions of $^{233}UO_2(NO_3)_2$ or $^{233}UO_2F_2$ are also included. The only critical lattice data using both ^{233}U and Th came from the LWBR program. All these experiments were zoned radially and in most cases axially also. Geometrically clean lattice critical data were measured for the CETR and TUPE programs. Both series used $^{235}UO_2$-ThO_2 pellets. A series of 21 exponential experiments using 3% $^{233}UO_2$ - 97% ThO_2 fuel vibratory compacted to 92% of theoretical density in Zircaloy-2 tubing was performed at BNL using both unpoisoned and boric acid poisoned H_2O moderator. For completeness, homogeneous systems are listed in which basic neutronics data have been measured. However, it is expected that most data concerning homogeneous systems will be applied to criticality safety problems rather than neutronics methods validation.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 44864, 45150

44803 (CONF-790802—1) **Dynamic plastic buckling of shells: a reconsideration of the Vaughan—Florence analysis.** Horvay, G.; Veluswami, M.A.; Stockton, F.D. (Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering). Jan 1979. Contract EY-76-S-02-4122. 25p. Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

A study aimed at extending the VF analysis to encompass axial variation of the impulse load revealed that the Ω^2 term may not be neglected, because it constitutes the only restraint on the motion that is caused by the departure from axial uniformity. This suggested reconsidering also the original VF analysis, for axial uniformity, with the Ω^2 term retained. It is found that the maximum amplification is drastically reduced by retention of the Ω^2 term, by a factor close to 3 in VF's example, and is reached in a time about 25% below that given by VF. Their critical mode number is only slightly shifted: from $n = 16$ to $n = 17$. Various ramifications of the numerical integration scheme are also explored. It is found that about $N = 20000$ integration steps is optimal.

44804 (CONF-7708113—P1, pp 123-129) **Thermal stress analysis of nuclear reactor components.** Beer, G.; Pircher, H. (Bureau for Electronic Computation, Graz, Austria). 1977.

From 6. Australasian conference on the mechanics of structures and materials; Christchurch, New Zealand (22 Aug 1978).

Analysis of parts and ancillary equipment of nclear reactors are discussed. The Finite Element Method is used to determine both the transient temperature distribution and the associated stresses and deformations. Because of the extreme thermal boundary conditions material nonlinearities have to be considered in the analysis. A unified approach to the treatment of plasticity and creep is presented. 13 references.

44805 (EPRI-NP—1026) **Decision methodology for improved plant reliability.** Thomas, J.M.; Bosinoff, P.R. (Failure Analysis

Associates, Palo Alto, CA (USA)). Mar 1979. 49p. Dep. NTIS, PC A03/MF A01.

A methodology is developed for identifying cost-effective failure prevention strategies for components or systems of nuclear power plants. Improvement of component reliability and addition of redundant components are identified as two basic strategies. Statistical decision theory is adopted as the tool for determining the optimum course of action among the strategies studied on the basis of minimum expected cost. A reliability analysis is developed as an important input to the decision model. Both repairable and nonrepairable systems are examined, and an example problem is developed for repairable systems. It is clearly shown that large expenditures are justified to improve the reliability of some major systems in nuclear power units and that these expenditures, even though they can exceed the original capital cost of the system, could save tens of millions of dollars per installation.

44806 Application of the self-powered detector concept in the design of a threshold gamma-ray detector. LeVert, F.E. (Argonne National Lab., IL). *Nucl. Technol.;* 44: No. 1, 188-191(Jun 1979).

The self-powered detector concept has been utilized to develop an energy threshold gamma-ray detector. Gamma-ray energy discrimination is achieved by using a thick annular lead shield around the outer wall (emitter) of the detector in conjunction with a self-shielding central electrode (collector). Measurements conducted in the graphite pit of the Argonne Thermal Source Reactor have confirmed its ability to detect high-energy prompt fission gamma rays while discriminating against a significant flux of low-energy gamma rays from the decay of fission products. Also, auto-power spectral densities obtained with the detector were used to estimate the kinetic parameter, β/l, of the reactor.

44807 Apparatus for controlling nuclear core debris. Jones, R.D. (to Dept. of Energy). US Patent 4,116,764. 26 Sep 1978. Filed date 11 Feb 1976. 10p.

PAT-APPL-656,992.

Disclosed is an apparatus for containing, cooling, and dispersing reactor debris assumed to flow from the core area in the unlikely event of an accident causing core meltdown. The apparatus includes a plurality of horizontally disposed vertically spaced plates, having depressions to contain debris in controlled amounts, and a plurality of holes therein which provide natural circulation cooling and a path for debris to continue flowing downward to the plate beneath. The uppermost plates may also include generally vertical sections which form annular-like flow areas which assist the natural circulation cooling.

44808 Method and apparatus for removing the surface layer from a concrete object. Allen, C.H. (to Dept. of Energy). US Patent Application 880,920. 24 Feb 1978. 7p.

Disclosed is a method and apparatus for removing the surface layer from a concrete object. The method consists of providing a hole having a circular wall in the surface layer of the object, the hole being at least as deep as the thickness of the surface layer to be removed, and applying an outward wedging pressure on the wall of the hole sufficient to spall the surface layer around the hole. By the proper spacing of an appropriate number of holes, it is possible to remove the entire surface layer from an object. The apparatus consists of an elongated tubular-shaped body having a relatively short handle with a solid wall at one end, the wall of the remainder of the body containing a plurality of evenly spaced longitudinal cuts to form a relatively long expandable section, the outer end of the expandable section having an expandable, wedge-shaped spalling edge extending from the outer surface of the wall, perpendicular to the longitudinal axis of the body, and expanding means in the body for outwardly expanding the expandable section and forcing the spalling edge into the wall of a hole with sufficient outward pressure to spall away the surface layer of concrete. The method and apparatus are particularly suitable for removing suface layers of concrete which are radioactively contaminated.

44809 Valve system incorporating single failure protection logic. Ryan, R. (to Dept. of Energy). US Patent Application 868,634. 11 Jan 1978. 7p.

Disclosed is a valve system incorporating single failure protective logic. The system consists of a valve combination or composite valve which allows actuation or de-actuation of a device such as a hydraulic cylinder or other mechanism, integral with or separate from the valve assembly, by means of three independent input signals combined in a function commonly known as two-out-of-three logic. Using the input signals as independent and redundant actuation/de-actuation signals a single signal failure, or failure of the corresponding valve or valve set, will neither prevent the desired action, nor cause the undesired action of the mechanism.

FUEL ELEMENTS

44810 (RE-P—77-044) Evaluation of analytical capabilities for accurate prediction of isotopic correlation ratios. Ottewitte, E.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1977. Contract EY-76-C-07-1570. 135p. Dep. NTIS, PC A07/MF A01.

The purpose of the study is to evaluate the availability and accuracy of existing methods for predicting fission product, cladding-mutant, and actinide concentrations and isotopic ratios in discharged reactor fuel elements after various irradiation and cooling (minimum of three months) times. This type of calculation involving theoretical predictions may be referred to as a forward calculation. The overall goal is to be able to identify fuel and reactor types and reconstruct irradiation history (backwards calculations) from correlations of key nuclides. Initial attention is centered on the forward calculation: this is the area where significant work seems to have been done.

44811 Electroplating method and apparatus. Looney, R.B.; Smith, W.E.L. (to Dept. of Energy). US Patent 4,096,042. 20 Jun 1978. Filed date 4 Apr 1969. 8p.

PAT-APPL-814,894.

Disclosed is an apparatus for high speed electroplating or anodizing tubular members such as nuclear reactor fuel elements. A loading arm positions the member on a base for subsequent support by one of two sets of electrical contacts. A carriage assembly positions electrodes into and around the member. Electrolyte is pumped between the electrodes and the member while electric current is applied. Programmed controls sequentially employ each of the two sets of contacts to expose all surfaces of the member to the electrolyte. The member is removed from the apparatus by an unloading arm.

44812 Method and means of packaging nuclear fuel rods for handling. Adam, M.F. (to Dept. of Energy). US Patent Application 902,184. 2 May 1978. 6p.

Nuclear fuel rods, especially spent nuclear fuel rods that may show physical distortion, are encased within a metallic enclosing structure by forming a tube about the fuel rod. The tube has previously been rolled to form an overlapping tubular structure and then unrolled and coiled about an axis perpendicular to the tube. The fuel rod is inserted into the tube as the rolled tube is removed from a coiled strip and allowed to reassume its tubular shape about the fuel rod. Rollers support the coiled strip in an open position as the coiled strip is uncoiled and allowed to roll about the fuel rod.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 44727, 44728, 44854, 45361, 45362

SITING

REFER ALSO TO CITATION(S) 45474, 45475

44813 (SAN—1011-119) Review of earthquake vibratory ground motion intensity attenuation relationships. Young, G.A. (Agbabian Associates, El Segundo, CA (USA)). 30 Sep 1978. Contract EY-76-C-03-1011. 104p. Dep. NTIS, PC A06/MF A01.

The objective of this report is to provide a review of earthquake vibratory ground motion intensity-distance-attenuation relationships which depicts the evolution and limitations of currently used procedures. Two general procedures are considered; one procedure relates peak horizontal ground acceleration, earthquake magnitude, and distance, and the other relates epicentral Modified Mercalli Intensity (MMI), distance, and attenuated MMI. A conversion relatiohsip between MMI and peak horizontal ground acceleration is used with the latter.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 45214, 45359

44814 (EPRI-NP—1013) Airborne particulate releases from light-water reactors. Final report. Cline, J.E.; Pelletier, C.A.; Frederickson, J.P.; Voilleque, P.G.; Barefoot, E.D. (Nuclear Environmental Services, Rockville, MD (USA)). Mar 1979. 99p. Dep. NTIS, PC A05/MF A01.

The report provides a summary of airborne particulate releases from light-water reactors. A computer data base has been built that contains all of the data on airborne particulate concentrations in ventilation and off-gas systems that were obtained in EPRI Research Project 274-1 and reactor coolant radionuclide concentrations for the same period. The data base has been used to compute normalized release rates for the particulates as a function of time, average

normalized release rates for each area of the plant for four different operating modes of each plant, and average normalized rates for each plant assuming normal (defined) operation over a year. Conclusions of the study indicate that particulates, like radioiodine are released from a few principal areas. These releases are correlated to reactor coolant concentrations and to the plant power operations but to a lesser extent than that observed for radioiodine. Since the initial experiments were not designed to measure particulates other than radioiodine, the quality of the data does not warrant additional modeling, none was attempted.

44815 (SAND—77-0736) **Entrainment of a developing plume into convective cells.** Wayland, J.R. Jr.; Ritchie, L.T. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

The assessment of risk associated with a hypothetical nuclear reactor accident which releases radioactive material into the atmosphere requires modeling of the interaction between the developing plume and rainstorms. An important consideration is the entrainment of this plume by convective cells of a thunderstorm. A simple method for estimating the dilution of the concentration of radionuclides in an entrained plume is presented. The effects upon calculated risks when a plume is entrained into a thunderstorm showed considerable changes from those calculated using a simple homogeneous washout model.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 45454, 45459

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 44831, 44837, 44848, 44849, 44859

44816 (ANL—78-104) **Investigations of materials compatibility relevant to the EBR-II system, FY 1978.** Longua, K.J.; Shields, J.A.; Ruther, W.E.; Olson, W.H. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-48. 23p. AT.

Thermocouple assemblies used to monitor sodium piping failed in FY 1977. The examination in FY 1978 showed that these corrosion failures of the thermocouples have not caused any degradation of the sodium piping. Evaporator EV-702 was ultrasonically inspected for the second annual inspection. The in-service inspection of the steam system and the secondary sodium system did not reveal any evidence of material degradation or defects in any pipe welds. An EBR-II periscope used to examine reactor internals became inoperative owing to deposition of sodium aerosol on its faceplate. A method was devised for preventing such deposition. Various illumination sources for the periscope were evaluated, and a GE sealed-beam lamp was recommended. Notch tensile tests did not detect any difference in notch sensitivity between 12%-cold-worked AISI 316 and annealed AISI 304 stainless steels after irradiation.

44817 (ANL—79-11) **Status and development potential of plate-type fuels for research and test reactors.** Stahl, D. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

Recent U.S. Department of State action to restrict the shipment and use of highly enriched uranium for research and test reactors has renewed fuel development activity. The objective of these development activities is to increase the total uranium loading in the fuel meat so that enrichment reduction can be accomplished without significant performance penalties. The report characterizes the status and the potential for development of the currently utilized plate-type fuels for research and test reactors. The report also characterizes the newer high-density fuels which could be utilized in these reactors and indicates the impact of the utilization of both the new and current fuels on enrichment reduction.

44818 (BNL—26197) **TRISTAN-II at Brookhaven.** Chrien, R.E.; Stelts, M.L.; Manzella, V.; Gill, R.; Wohn, F.; Hill, J.C. (Brookhaven National Lab., Upton, NY (USA); Ames Lab., IA (USA)). 1979. Contract EY-76-C-02-0016. 18p. (CONF-790566—1). Dep. NTIS, PC A02/MF A01.

From Workshop on nuclear spectroscopy of fission products; Grenoble, France (21 May 1979).

The mass separator TRISTAN has been moved to Brookhaven HFBR. A flux of up to 10^{11} neutrons/cm^2/sec will be available on target, and improvements in the ion source and beam optics have been made. A computer system with a CAMAC interface allows data collection from eight independent sources, while a PDP-11/34 computer is available for extensive off-line analysis.

44819 (CONF-790505—16) **LOFT liquid level transducer application techniques and measurement uncertainty.** Batt, D.L.; Biladeau, G.L.; Goodrich, L.D.; Nightingale, C.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 11p. Dep. NTIS, PC A02/MF A01.

From 25. ISA international instrumentation symposium; Anaheim, CA, USA (7 May 1979).

A conductivity sensitive liquid level transducer (LLT) has been designed and used successfully for determining whether steam or water is present in the Loss-of-Fluid Tests (LOFT) performed by EG and G Idaho, Inc., at the Idaho National Engineering Laboratory. The presence of steam or water is determined by establishing a discriminator level which is set manually. A computer program establishes the presence or absence of water for each data point taken. In addition to liquid level, the LLT is used for reactor vessel mass and volume calculations. The uncertainty in the liquid level is essentially the spacing of the LLT electrodes.

44820 (CONF-790602—60) **Interlaboratory computational comparisons of critical fast test reactor pin lattices.** Mincey, J.F.; Kerr, H.T.; Durst, B.M. (Oak Ridge National Lab., TN (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

An objective of the Consolidated Fuel Reprocessing Program's (CFRP) nuclear engineering group at Oak Ridge National Laboratory (ORNL) is to ensure that chemical equipment components designed for the reprocessing of spent LMFBR fuel (among other fuel types) are safe from a criticality standpoint. As existing data are inadequate for the general validation of computational models describing mixed plutonium—uranium oxide systems with isotopic compositions typical of LMFBR fuel, a program of critical experiments has been initiated at the Battelle Pacific Northwest Laboratories (PNL). The first series of benchmark experiments consisted of five square-pitched lattices of unirradiated Fast Test Reactor (FTR) fuel moderated and reflected by light water. Calculations of these five experiments have been conducted by both ORNL/CFRP and PNL personnel with the purpose of exploring how accurately various computational models will predict k/sub eff/ values for such neutronic systems and if differences between k/sub eff/ values obtained with these different models are significant.

44821 (LTR—125-8) **LOFT CIS analysis penetration S-7A 8" WW - 172-AB.** Barry, W.J. Jr. (Idaho National Engineering Lab., Idaho Falls (USA)). 13 Nov 1978. Contract EY-76-C-07-1570. 61p. (RE-A—78-164). Dep. NTIS, PC A04/MF A01.

The 8" WW - 172 - AB line from the containment penetration S-7A was analyzed to ASME Code, Subsection NC (Class 2) criteria. This section of piping is part of the LOFT Containment Isolation System. The model considered the line from the penetration S-7A outward through two horizontal-plane elbows and then through three valves to a wall penetration. Results of the analysis show that the system will meet Class 2 requirements if additional support/restraint is installed at three locations besides the existing restraints. The locations and loads for these supports/restraints are included in the body of the report.

44822 (LTR—132-3) **Loft cis analysis: 4"-IW-179-AB inside containment penetration S-5B.** Moha, J.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 26 Mar 1979. Contract EY-76-C-07-1570. 82p. (RE-A—78-151). Dep. NTIS, PC A05/MF A01.

A stress analysis was performed on the 4"-IW-179-AB piping system inside containmet penetration S-5B. Deadweight, thermal expansion, and seismic loads were considered. The results indicate that this piping will meet ASME Section III, Class 2 requirements.

44823 (LTR—141-86) **Stress analysis of ultrasonic density detector for LOFT core inlet steady-state and LOCE conditions.** Mosby, W.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 26 Mar 1979. Contract EY-76-C-07-1570. 63p. (RE-A—78-185). Dep. NTIS, MF A01.

Portions of document are illegible.

Stresses were calculated in the Ultrasonic Density Detector due to steady-state fluid loads and LOCE fluid and thermal loads. All stresses were found to be within ASME Boiler and Pressure Vessel Code allowables, the UDD sensor bar was found able to withstand 10,400 LOCE's, and sensor bar natural frequencies were found to be high enough to avoid resonance due to flow induced vibration, (assuming the recommended design changes (EG and G Drawings 208448, Revision B and 208877, Revision A) are made).

44824 (LTR—141-94) **Thermal analysis of gamma densitometer mounts.** Tatar, G.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 22 Mar 1979. Contract EY-76-C-07-1570. 75p. (RE-A—78-204). NTIS MFA01.

Portions of document are illegible.

The gamma densitometers are supported by three different types of mounts: (1) lower shield mounts; (2) upper shield mounts; and (3) source shield mounts. In this analysis each mount was subjected to steady state, LOCE and heat up conditions. The LOCE

transient conditions used were a combination of measured heat transfer coefficients from a similar location in the semiscale facility and RELAP4 predicted coolant temperatures for the L2-4 test. These conditions are adequate for use in the L-2 series tests. This analysis was performed using COUPLE, a finite element two-dimensional heat conduction code. The temperature histories produced by this analysis were supplied on magnetic tape to Science Applications, Inc., for use in the thermal stress analysis.

44825 (LTR—1111-57) **LOFT calibration tube thermal expansion analysis.** Tatar, G.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 9 Nov 1978. Contract EY-76-C-07-1570. 18p. (RE-A—78-230). Dep. NTIS, PC A02/MF A01.

This analysis is in response to a request to determine the maximum relative linear displacement of the lower end of the calibration tube towards the bottom of the guide tube that can occur during any operating mode of the LOFT reactor. It was found that the worst case occurs during nuclear test L2-4 with a maximum displacement of 0.78 inches at 40 seconds. This is a conservative value and no factors should be applied for analysis uncertainties.

44826 (LTR—1122-4) **Thermal analysis of LOFT waste gas processing system nitrogen supply for process line purge and blower seal.** Tatar, G.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 17 Apr 1979. Contract EY-76-C-07-1570. 32p. (RE-A—78-276). Dep. NTIS, PC A03/MF A01.

The LOFT Waste Gas Processing System uses gaseous nitrogen (GN_2) to purge the main process line and to supply pressure on the blower labyrinth seal. The purpose of this analysis was to determine the temperature of the GN_2 at the blower seals and the main process line. Since these temperatures were below 32°F the heat rate necessary to raise these temperatures was calculated. This report shows that the GN_2 temperatures at the points mentioned above were below 10°F. A heat rate into the GN_2 of 389 Watts added at the point where the supply line enters the vault would raise the GN_2 temperature above 32°F.

44827 (LTR—1217-7) **Recalculation of loads on LOFT penetrations 1A, 2A, 3E, 3F, 5A, 5B, 5C, 5D, 5E, 5F, 7A, 9A, 11C, 17A, 17B, 20A, 20B, 20C, 21A.** McFadden, D.F. (Idaho National Engineering Lab., Idaho Falls (USA)). 31 Oct 1978. Contract EY-76-C-07-1570. 119p. Dep. NTIS, PC A06/MF A01.

The loads on the piping nozzles penetrating the LOFT containment vessel are presented. Since the design and construction of the containment vessel, piping systems that penetrate the nozzles have been changed. Consequently, the moments and forces on the containment vessel are different than those stated in LOFT specification S-1. Two combined load cases were tabulated, deadweight plus thermal expansion plus operating basis earthquake and deadweight plus safe shutdown earthquake.

44828 (SAND—78-2145) **Two-region core design concepts for the upgrade of the annular core pulse reactor.** Pickard, P.S.; Odom, J.P. (Sandia Labs., Albuquerque, NM (USA); Science Applications, Inc., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 61p. Dep. NTIS, PC A04/MF A01.

This report describes physics and core-design calculations completed as a part of a design study for upgrading the Annular Core Pulse Reactor. The calculated details and the design results are presented as a basis of comparison of two inner region fuel types, UO_2 - BeO and UC-ZrC-C. The inner fuel had a high-heat capacity, providing a high-neutron fluence while the outer fuel, U-$ZrH_{1.8}$, maintained a large negative temperature coefficient. A single region core design based on UO_2 - BeO fuel was eventually chosen for the upgrade of the ACPR.

44829 **Critical experiments with fast test reactor fuel pins in water.** Bierman, S.R. (Battelle-Pacific Northwest Labs., Richland, WA); Durst, B.M.; Clayton, E.D.; Scherpelz, R.I.; Kerr, H.T. *Nucl. Technol.;* **44**: No. 1, 141-151(Jun 1979).

A series of criticality experiments with fast test reactor (FTR) fuel pins in water has been performed in support of the Advanced Fuel Recycle Program (AFRP). The objective of these experiments was to provide clean, easily defined criticality data on AFRP-type fuel pins in water for use in verifying calculational techniques and nuclear data used in calculations. Measurement data were obtained on water-flooded square lattices of FTR fuel pins. The number of fuel pins required for criticality was determined at lattice pitches of 7.7, 9.5, 9.7, 12.6, 15.3, and 19.1 mm to be 1268, 605, 580, 279, 205, and 162, respectively. These center-to-center fuel pin spacings correspond to water-to-fuel volume ratios of 1.67, 3.33, 3.49, 6.87, 10.88, and 17.53, respectively, and cover the neutron moderation range from near optimum to the highly undermoderated. KENO-IV calculations with ENDF data from the AMPX system overestimated the experimental results by 1 to 2% in k/sub eff/. KENO-IV calculations with FLANGE-ETOG-THERMOS-EGGNIT-processed ENDF data resulted in calculated values 1 to 6% high in k/sub eff/.

PROPULSION REACTORS

44830 (LA-UR—79-1243) **Reactor design for nuclear electric propulsion.** Koenig, D.R.; Ranken, W.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790803—24). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Conceptual design studies of a nuclear power plant for electric propulsion of spacecrafts have been on going for several years. An attractive concept which has evolved from these studies and which has been described in previous publications, is a heat-pipe cooled, fast spectrum nuclear reactor that provides 3 MW of thermal energy to out-of-core thermionic converters. The primary motivation for using heat pipes is to provide redundancy in the core cooling system that is not available in gas or liquid-metal cooled reactors. Detailed investigation of the consequences of heat pipe failures has resulted in modifications to the basic reactor design and has led to consideration of an entirely different core design. The new design features an integral laminated core configuration consisting of alternating layers of UO_2 and molybdenum sheets that span the entire diameter of the core. Design characteristics are presented and compared for the two reactors.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 45104, 45214

44831 (ANL/EBR—104) **Compilation of data from EBR-II natural-circulation-test procedure EX-140, Section IV, Addendum 7A.** Gillette, J.L.; Sullivan, J.E.; Singer, R.M.; Tokar, J.V.; Dean, E.M. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 167p. AT.

The transition from forced primary-coolant flow to natural-circulation flow following the loss of primary pumping power with concomitant reactor scram has been investigated in Experimental Breeder Reactor II. Before the loss-of-flow transient, the reactor was operated at 17.1 MWt (28.5% of the normal full-power value) and at 33% of normal full flow. All electrical power to the primary pumping system was terminated, causing the flow rate of the primary-system coolant to coast down. As the flow rate coasted down, the low-flow trip setting caused the reactor to scram. The transition from forced to natural-circulation flow was observed to be smooth, and the coolant temperatures throughout the reactor were observed to remain lower than the corresponding values at full-power operating conditions. The corrected test data are presented graphically.

44832 (BNL-NUREG—25297) **Flow dynamics of volume-heated boiling pools.** Ginsberg, T.; Jones, O.C.; Chen, J.C. (Brookhaven National Lab., Upton, NY (USA); Lehigh Univ., Bethlehem, PA (USA). Dept. of Mechanical Engineering and Mechanics). 1979. Contract EY-76-C-02-0016. 13p. (CONF-790808—2). Dep. NTIS, PC A02/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

Safety analyses of fast breeder reactors require understanding of the two-phase fluid dynamic and heat transfer characteristics of volume-heated boiling pool systems. Design of direct contact three-phase boilers, of practical interest in the chemical industries also requires understanding of the fundamental two-phase flow and heat transfer behavior of volume boiling systems. Several experiments have been recently reported relevant to the boundary heat-loss mechanisms of boiling pool systems. Considerably less is known about the two-phase fluid dynamic behavior of such systems. This paper describes an experimental investigation of the steady-state flow dynamics of volume-heated boiling pool systems.

44833 (BNL-NUREG—25519) **Application of multiple timestep integration method in SSC.** Guppy, J.G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790816—4). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The thermohydraulic transient simulation of an entire LMFBR system is, by its very nature, complex. Physically, the entire plant consists of many subsystems which are coupled by various processes and/or components. The characteristic integration timesteps for these processes/components can vary over a wide range. To improve computing efficiency, a multiple timestep scheme (MTS) approach has been used in the development of the Super System Code (SSC). In this paper: (1) the partitioning of the system and the timestep control are described, and (2) results are presented showing a savings in computer running time using the MTS of as much as five times the time required using a single timestep scheme.

44834 (BNL-NUREG—25618) **Dynamic simulation of LMFBR plant under natural circulation.** Agrawal, A.K.; Guppy, J.G.; Madni, I.K.; Weaver, W.L. III. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 42p. (CONF-790808—8). Dep. NTIS, PC A03/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

An adequate dissipation of after-heat via natural circulation can be demonstrated by dynamic simulation of the entire LMFBR plant. Models needed to accomplish this task are briefly described in the paper. The resulting computer code, SSC-L, is then applied to simulate the response of the Clinch River Breeder Reactor Plant for a loss-of-electric power transient. Entire simulation is performed for 1800 seconds of the transient time. The decay heat removal via natural circulation is shown. The effect of internal flow redistribution in the reactor core is also demonstrated.

44835 (BNL-NUREG—25716) **Experimental investigations of nonequilibrium flashing of water in a converging-diverging nozzle.** Zimmer, G.A.; Wu, B.J.C.; Leonhardt, W.J.; Abuaf, N.; Jones, O.C. Jr. (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract EY-76-C-02-0016. 36p. (CONF-790808—6). Dep. NTIS, PC A03/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

A steady water loop with well controlled flow and thermodynamic conditions was designed, built, and made operational to measure the net vapor generation rates under nonequilibrium conditions. The test section consists of a converging-diverging nozzle with 49 pressure taps and observation windows at the exit. First pressure distributions and photographic observations were recorded under various flashing conditions. The effect of the various parameters such as inlet pressure, inlet temperature, mass flux, and back pressure on the pressure distributions and flashing regimes have been investigated and are reported here. Under specific flashing conditions, a sharp increase in pressure (condensation shock) was observed in the diverging section (which accomodates the high back pressures). The experiments are being continued with a γ densitometer to measure the void fraction distributions needed in the vapor generation rate calculations.

44836 (CAAP-TR—049) **Comparison of RELAP4/MOD6 to THTF Test 177.** Davis, C.B. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1979. Contract EY-76-C-07-1570. 46p. Dep. NTIS, PC A03/MF A01.

The ability of the RELAP4/MOD6 computer code to predict the behavior of a pressurized water reactor core during the blowdown phase of a loss-of-coolant accident was assessed. Predictions of a core component model were compared with data from a Thermal-Hydraulic Test Facility blowdown experiment.

44837 (CONF-790441—1) **LOFT fuel module structural response during loss-of-coolant experiments.** Saffell, B.F. Jr.; Selcho, H.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 9p. Dep. NTIS, PC A02/MF A01.

From ANS topical meeting on light water reactor fuel performance; Portland, OR, USA (29 Apr 1979).

The structural response of the reactor fuel modules installed in the Loss-of-Fluid Test (LOFT) facility have been analyzed for subcooled blowdown loading conditions associated with loss-of-coolant experiments (LOCE). Three independent analyses using the WHAM, SHOCK, and SAP computer codes have been interfaced to calculate the transient mechanical behavior of the LOFT fuel. Test data from two LOCEs indicate the analysis method is conservative. Structural integrity of the fuel modules has been assessed by monitoring guide tube temperatures and control rod drop times during the LOCEs. The analysis and experimental test data indicate the fuel module structural integrity will be maintained for the duration of the LOFT experimental program.

44838 (CONF-790441—4) **Damage and failure of unirradiated and irradiated fuel rods tested under film boiling conditions.** Mehner, A.S.; Hobbins, R.R.; Seiffert, S.L.; MacDonald, P.E.; McCardell, R.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 20p. Dep. NTIS, PC A02/MF A01.

From ANS topical meeting on light water reactor fuel performance; Portland, OR, USA (29 Apr 1979).

Power-cooling-mismatch experiments are being conducted as part of the Thermal Fuels Behavior Program in the Power Burst Facility at the Idaho National Engineering Laboratory to evaluate the behavior of unirradiated and previously irradiated light water reactor fuel rods tested under stable film boiling conditions. The observed damage that occurs to the fuel rod cladding and the fuel as a result of film boiling operation is reported. Analyses performed as a part of the study on the effects of operating failed fuel rods in film boiling, and rod failure mechanisms due to cladding embrittlement and cladding melting upon being contacted by molten fuel are summarized.

44839 (CONF-790505—15) **Pitot tube and drag body measurements in transient steam—water flows.** Fincke, J.R.; Deason, V.A.; Dacus, M.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 11p. Dep. NTIS, PC A02/MF A01.

From 25. ISA international instrumentation symposium; Anaheim, CA, USA (7 May 1979).

The use of full-flow drag devices and rakes of water-cooled Pitot tubes to measure the transient two-phase mass flow during loss-of-coolant experiments in pressurized water reactor (PWR) environments has been developed. Mass flow rate measurements have been obtained in high temperature and pressure environments, similar to PWRs, under transient conditions. Comparisons of the measured time integrated value of mass flow to the known system mass before depressurization are made.

44840 (CONF-790519—3) **Two-dimensional temperature distributions in fuel rods under blowdown conditions.** Sdouz, G.; Dagbjartsson, S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

In the case of a loss-of-coolant accident (LOCA) in a light water reactor, the fuel rod cladding may reach temperatures which cause ballooning and rupture. To investigate the potential azimuthal temperature difference on the surface, a series of calculations were performed using the FRAP-T4 (Fuel Rod Analysis Program Transient) computer code. FRAP-T4 is capable of simulating the state of fuel rods during a LOCA, in particular the two-dimensional (r - θ) temperature distribution. Most of the effects relevant to LOCA behavior are modeled in the code. The calculations were performed for a fuel rod typical of a 17 x 17 pressurized water reactor (PWR) fuel assembly subjected to simplified blowdown thermal hydraulic conditions.

44841 (CONF-790519—5) **Use of moving heat conductor mesh to perform reflood calculations with RELAP4/MOD6.** Fischer, S.R.; Ellis, L.V.; Chen, Y.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 9p. Dep. NTIS, PC A02/MF A01.

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

RELAP4 is a computer code which can be used for the transient thermal hydraulic analysis of light water reactors and related systems. RELAP4/MOD6 includes many new analytical models which were developed primarily for the analysis of the reflood phase of a PWR loss-of-coolant accident (LOCA) transient. The key feature forming the basis for the MOD6 reflood calculation is a unique moving finite differenced heat conductor. The development and application of the moving heat conductor mesh for use in reflood analysis are described.

44842 (CONF-790646—1) **Thermal fuels behavior program. Program overview and research results.** Zeile, H.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 15p. Dep. NTIS, PC A02/MF A01.

From International colloquium on irradiation for reactor safety programmes; Petten, Netherlands (25 Jun 1979).

This paper is an overview of the results for the last 12 months of Thermal Fuels Behavior Program (TFBP) research being conducted in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory. TFBP is an integral experimental and analytical program designed to provide information on the behavior of light water reactor fuels under normal, off-normal, and accident conditions. The PBF reactor core can be operated to provide test conditions typical of off-normal conditions such as loss-of-coolant accidents (LOCA), power-cooling-mismatch (PCM) accidents, reactivity initiated accidents (RIA), operational transients with or without scram (OPTRAN), and inlet flow blockages (IFB). During the last 12 months, fuel behavior testing in the PBF consisted of seven RIA tests and three LOCA tests. The RIA tests performed were the PBF Lead Rod Tests, the RIA Scoping Test Series, and Tests RIA 1-1 and RIA 1-2. The LOCA tests consisted of the PBF Loss-of-Fluid Test (LOFT) Lead Rod Test Series. In the future, the TFBP is scheduled to conduct a second 9-rod bundle PCM test (Test PCM-7), a combination RIA/PCM test (Test PR-1), four LOCA tests (Tests LOC-3, LOC-5, LOC-7, and LOC-8), the first 9-rod bundle RIA test with irradiated rods (Test RIA 1-4), a thermocouple effects test (Test TC-1), additional RIA bundle tests, and start an operational transient test series.

44843 (CONF-790646—7) **Fuel rod behavior during a reactivity initiated accident at energy depositions near 280 cal/g UO_2.** Seiffert, S.L.; Owen, D.E.; Shiozawa, S. (Idaho National Engineering Lab., Idaho Falls (USA); Japan Atomic Energy Research Inst., Tokyo). 1979. Contract EY-76-C-07-1570. 30p. Dep. NTIS, PC A03/MF A01.

From International colloquium on irradiation for reactor safety programmes; Petten, Netherlands (25 Jun 1979).

Experimental results from three recent Power Burst Facility (PBE) reactivity initiated accident (RIA) tests, performed at energy depositions (260 to 320 cal/g UO_2) near the U.S. Nuclear Regulatory Commission's criterion of 280 cal/g UO_2 enthalpy insertion, are discussed. The RIA fuel behavior experiments are being conducted at coolant conditions typical of hot-startup in a commercial boiling water reactor. Post irradiation examination of both previously unirradiated and irradiated test fuel rods revealed cladding deformation and wall-thickness variations, fuel swelling accompanying melting and failure (in previously irradiated fuel), cladding oxidation and embrittlement, and rod fragmentation and fuel powdering. A distinction is made between fuel rod damage resulting from the short duration power burst and from the subsequent period of sustained film boiling. Particular emphasis is placed on the order of occurrence of the damage events and differences in behavior of previously unirradiated and irradiated fuel rods.

44844 (EPRI-NP—1027-SR) **RAP: a simple core reflood analysis program.** Oehlberg, R.N.; Falotico, R.N.; Duffey, R.B. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1979. 33p. Dep. NTIS, PC A03/MF A01.

The Reflood Analysis Program (RAP), a computer code, describes the nuclear steam supply system response to the reflood portion of a hypothetical loss-of-coolant accident. The primary output from RAP (as a function of time) includes the following: quench front velocity, reflood rate, quench front height, and core pressure. System performance parameters are required as input. The RAP governing equations are described, and a definition of variables in the computer code is presented. A computer code listing and a sample problem are provided, along with the results from the sample problem run. A user's section explains the use of the RAP computer code and describes the required input.

44845 (EPRI-NP—1039) **Probabilistic safety analysis IV. Final report.** Erdmann, R.C. (Science Applications, Inc., Palo Alto, CA (USA)). Apr 1979. 77p. Dep. NTIS, PC A05/MF A01.

The primary goal of the study has been to continue development of probabilistic risk assessment methodology and its applicability to utility requirements. Improvements have been developed for methods of fault tree analysis, consequence analysis, and ATWS data collection and retrieval. Progress has been documented for an analysis of external fuel cycle risks. A technique has been developed for applying regional seismic histories to analyses of risk from earthquakes.

44846 (HEDL-TME—78-80) **Experimental study of hydrogen jet ignition and jet extinguishment.** Wierman, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 114p. Dep. NTIS, PC A06/MF A01.

Two phases are described of an experimental study that investigated: (1) the ignition characteristics of hydrogen—sodium jets, (2) the formation of hydrogen in sodium—humid air atmospheres, and (3) the extinguishment characteristics of burning hydrogen—sodium jets. Test conditions were similar to those postulated for highly-improbable breeder reactor core melt-through accidents and included: jet temperature, jet velocity, jet hydrogen concentration, jet sodium concentration, atmospheric oxygen concentration, and atmospheric water vapor concentration.

44847 (LA-UR—79-521) **Hydroelastic effects of a loss of coolant in a pressurized water reactor.** Dienes, J.K.; Hirt, C.W.; Rivard, W.C.; Stein, L.R.; Torrey, M.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790802—28). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

With the increasing demand for precise statements of nuclear reactor safety margins, and the importance of achieving the most efficient possible designs, there has emerged a need to develop more detailed analyses for reactor safety. In pressurized water reactors the design of the Core Support Barrel (CSB) is strongly influenced by the possibility of a cold leg break, which would lead to a large transient pressure differential across the CSB. In a first analysis it is natural to estimate its response as a cantilever beam, but because the shell is quite thin, and the length of the CSB rarely exceeds twice its radius, the possibility that local deformations might be important needs to be considered. For that reason a series of combined shell-fluid computer codes have been written to analyze the dynamic interactions. In SOLA-FLX1 only axial motion of the fluid is allowed, and in SOLA-FLX2 circumferential motion is added. In K-FIX(3D,FLX) radial motion of the fluid is allowed as well, and this permits three-dimensional motion of fluid in the core.

44848 (LTR—111-111) **L2-1/L2-2 pre-LOCE operation hybrid analysis.** Tylee, J.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 26 Mar 1979. Contract EY-76-C-07-1570. 242p. (RE-A—78-161). Dep. NTIS, PC A11/MF A01.

Ten accident conditions were examined: control rod withdrawal, control rod drop, loss of forced primary coolant flow, loss of steam load, steam load increase, failure of automatic pressure control system, inadvertent opening of reflood assist bypass valves, instantaneous loss of one pump flow, steamline rupture, and instantaneous loss of two pump flow. All of these accidents were analyzed using a hybrid computer simulation of the LOFT plant. Each accident was simulated for various sets of initial conditions.

44849 (LTR—1111-54(Rev.1)) **Postirradiation metallurgical techniques to estimate LOFT peak cladding temperatures.** Olsen, C.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 15 Feb 1979. Contract EY-76-C-07-1570. 80p. Dep. NTIS, PC A05/MF A01.

A comprehensive review of the zircaloy microstructure and oxidation characteristics was performed to establish the state-of-the-art capability for estimating peak cladding temperatures for LOCE's by postirradiation examination techniques. Cladding oxidation characteristics were compared with microstructure characteristics to determine the best approach. Deficiencies were identified in the low-temperature oxidation characteristics required for LOCE's, and an experimental plan is proposed to obtain low-temperature oxidation data which will expand the current data base and confirm the feasibility of estimating zircaloy cladding temperatures for transient conditions.

44850 (NUREG—0568) **Title list publicly available documents: Three Mile Island Unit 2, Docket 50-320. Cumulated to May 21, 1979.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). 1979. 155p. NTIS.

This title list of publicly available documents pertaining to Three Mile Island Unit 2, Docket 50-320, includes those preincident and postincident documents filed in the NRC Public Document Room as of May 21, 1979. It is divided into preincident and postincident listings, with both listings subdivided into the categories used for filing and searching in the NRC Public Document Room.

44851 (NUREG—0570) **Toxic vapor concentrations in the control room following a postulated accidental release.** Wing, J. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1979. 36p. NTIS.

An acceptable method is presented for calculating the vapor concentrations in a control room as a function of time after a postulated accidental release. Included are the mathematical formulas for computing the rates of vaporization and evaporation of liquid spills, the vapor dispersion in air, and the control room air exchange. A list of toxic chemicals and their physical properties is also given.

44852 (NUREG/CR—0665) **TRAC-P1A: An advanced best-estimate computer program for PWR LOCA analysis.** (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 384p. (LA—7777-MS). Dep. NTIS, PC A17/MF A01.

The Transient Reactor Analysis Code (TRAC) is being developed at the Los Alamos Scientific Laboratory to provide an advanced best estimate predictive capability for the analysis of postulated accidents in light water reactors. TRAC-P1A provides this analysis capability for pressurized water reactors and for a wide variety of thermal-hydraulic experimental facilities. It features a three-dimensional treatment of the pressure vessel and associated internals; two-phase nonequilibrium hydrodynamics models; flow-regime-dependent constitutive equation treatment; reflood tracking capability for both bottom flood and falling film quench fronts; and consistent treatment of entire accident sequences including the generation of consistent initial conditions.

44853 (NUREG/CR—0686) **Advanced two-phase flow instrumentation program. Quarterly progress report, July—September 1978.** Turnage, K.G.; Davis, C.E.; Thomas, D.G. (Oak Ridge National Lab., TN (USA)). 17 Apr 1979. Contract W-7405-ENG-26. 66p. (ORNL/NUREG/TM—309). Dep. NTIS, PC A04/MF A01.

A series of two-phase air-water tests with advanced spool piece I in horizontal flow is described. Nine drag body designs were tested to evaluate their suitability for two-phase momentum flux measurements by comparing drag flowmeter output with three independently calculated quantities. Preliminary analysis indicates that, in terms of drag flowmeter agreement with other estimates of the two-phase momentum flux, the blade-type targets and two perforated plate designs performed better than the other types. Analysis of data from the densitometer, turbine meter, and pressure-difference cell in the spool piece is also presented. Application of some two-phase mass flow models to the recorded data is discussed, and preliminary results are shown.

44854 (NUREG/CR—0691) **Bibliography of reports on research sponsored by the NRC Office of Nuclear Regulatory Research, July—December 1978.** Buchanan, J.R. (Oak Ridge National Lab., TN

(USA)). 6 Apr 1979. Contract W-7405-ENG-26. 136p. (ORNL/NUREG/NSIC—158). Dep. NTIS, PC A07/MF A01.

A bibliography of 245 reports distributed by contractors of the NRC Office of Nuclear Regulatory Research during the period July through December 1978 is presented along with abstracts from the Nuclear Safety Information Center computer file. The bibliography has been sorted into the subject categories used by NRC to organize the research program. Within the subject categories, the reports are arranged first by contractor organization and then chronologically. A brief description of the NRC research program precedes the bibliography.

44855 (NUREG/CR—0710) **Advanced two-phase flow instrumentation program quarterly progress report for October—December 1978.** Turnage, K.G.; Davis, C.E.; Thomas, D.G. (Oak Ridge National Lab., TN (USA)). 17 Apr 1979. Contract W-7405-ENG-26. 33p. (ORNL/NUREG/TM—313). Dep. NTIS, PC A03/MF A01.

A series of two-phase, air—water tests with advanced spool piece I in vertical downflow is described. The behavior of the tree-beam densitometer, turbine meter, and drag flowmeter is discussed in terms of two-phase models. Application of some two-phase mass flow models to the recorded spool piece data is made, and preliminary results are shown. Preparation for testing in the Oak Ridge National Laboratory (ORNL) Air-Water Test Facility of the three conductivity probes received from Atomic Energy of Canada Limited (AECL) is discussed.

44856 (NUREG/CR—0753) **Quarterly progress report on blowdown heat transfer separate-effects program for January—March 1979.** White, J.D.; Bohanan, R.E.; Clark, D.L. (Oak Ridge National Lab., TN (USA)). 1 May 1979. Contract W-7405-ENG-26. 27p. (ORNL/NUREG/TM—319). Dep. NTIS, PC A03/MF A01.

Fabrication of fuel pin simulators (FPSs) for Thermal-Hydraulic Test Facility (THTF) bundle 3 is proceeding satisfactorily. Two prototypes have undergone testing in the single-rod loop. Results have been very encouraging: no thermocouple failures, excellent repeatability of radial ΔT, and excellent repeatability of heater resistance. For these two prototypes, there are 78.8 total hours of power, with 30.4 hr at 122 kW. Testing of a third prototype is under way. Preliminary analysis using a two-dimensional version of the generaized heat conduction code, HEATING5, indicates a 1 to 3% surface heat flux perturbation in the vicinity of the thermocouple bead [boron nitride-backfilled (BNBF) thermocouple]. This very small perturbation in heat flux will provide heat transfer measurements far superior to those obtained with THTF bundle 1.

44857 (NUREG/CR—0780) **Analysis of aerosol particles undergoing gravitational agglomeration. Annual progress report, October 1, 1977—September 30, 1978.** Loyalka, S.K. (Missouri Univ., Columbia (USA). Coll. of Engineering). Feb 1979. 109p. NTIS, PC A06/MF A01.

Progress is summarized in development of appropriate theoretical expressions for the collision efficiency of LMFBR aerosol particles of arbitrary shape undergoing gravitational agglomeration and in experimental work to verify the theoretical expressions.

44858 (ORNL/TM—6773) **Fourteenth nuclear accident dosimetry intercomparison study: July 13—22, 1977.** Sims, C.S. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

The fourteenth in the continuing series of Nuclear Accident Dosimetry Intercomparison Studies was held July 13—22, 1977, at the Oak Ridge National Laboratory. The Health Physics Research Reactor, operated in the pulse mode, served as the radiation source. Four different shielding configurations (unshielded, 12-cm Lucite, 20-cm concrete, and 5-cm steel/15-cm concrete) helped simulate various nuclear criticality accident situations. Participants from eleven different organizations, seven domestic and four foreign, performed nuclear accident dose measurements during the study. Dosimeters used as area monitors as well as dosimeters on phantoms were intercompared under identical experimental conditions. Reported values of neutron dose were within +- 38% of the mean for all pulses while gamma ray doses were within +- 25% of the mean at one standard deviation.

44859 (QLR-L—2-3) **Quick-look report on LOFT Nuclear Experiment L2-3.** Reeder, D.L. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1979. Contract EY-76-C-07-1570. 75p. Dep. NTIS, PC A04/MF A01.

The preliminary evaluation has been completed of the results of the LOFT nuclear Loss-of-Coolant Experiment (LOCE) L2-3, which was successfully conducted on May 12, 1979. LOCE L2-3, the second experiment in the LOFT Power Ascension Series L2, simulated a complete double-ended offset shear break of a large pressurized water reactor inlet pipe. The initial conditions for LOCE L2-3 were selected to simulate the primary coolant and core conditions typical of a commercial reactor operating at normal power. Selected data confirm that the objectives of LOCE L2-3 were successfully achieved.

44860 (SAN—1011-113R) **Correlation of ground response spectra with modified mercalli site intensity. Topical report.** Werner, S.D.; Ts'ao, H.S. (Agbabian Associates, El Segundo, CA (USA)). 30 Sep 1978. Contract EY-76-C-03-1011. 168p. AT.

The objective of this study was to develop and update seismic design criteria and analysis methods for future LMFBR facilities. This report considers one aspect of this overall objective, namely, the development of intensity-dependent spectra for the following purposes: (1) to investigate ground response characteristics; (2) to provide a basis for assessing results from current procedures for defining seismic input criteria; and (3) to form the basis for new recommendations for developing criteria spectra to represent a given site intensity.

44861 (SAN—1011-118R) **Assessment of seismic analysis procedures for LMFBR in-core components.** (Agbabian Associates, El Segundo, CA (USA)). Mar 1979. Contract EY-76-C-03-1011. 71p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The report provides an assessment of state-of-the-art dynamic seismic analysis procedures for in-core components of liquid metal fast breeder reactors. It is based on a review of both United States and foreign published literature and upon discussions with technical personnel presently engaged in performing seismic design analyses of reactor in-core components.

44862 (SAND—78-1906C) **Full scale turbine—missile casing exit tests.** Yoshimura, H.R.; Schamaun, J.T.; Sliter, G.E. (Sandia Labs., Albuquerque, NM (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790802—24). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Two full-scale tests have simulated the impact of a fragment from a failed turbine disk upon the steel casing of a low-pressure steam turbine with the objective of providing data for making more realistic assessments of turbine missile effects for nuclear power plant designers. Data were obtained on both the energy-absorbing mechanisms of the impact process and the post-impact trajectory of the fragment. In both tests the target structure was a simplified model of a casing. The two main semicircular casing components that are expected to absorb most of the energy in a postulated failure were modeled: the internal blade ring which supports the stationary turbine blades (represented by a 12.7-cm-thick steel ring) and the outer casing cover (represented by a 3.2-cm-thick steel shell). The tests demonstrated that turbine casings can absorb substantial amounts of energy in slowing down or containing fragments from a postulated turbine failure. Additional testing and analysis are needed to quantify the energy that can be dissipated over a full range of impact conditions and to examine the possible mitigating effects of fragment rotation and off-normal orientation on subsequent impacts on outer concrete walls of power plants.

44863 (UCRL—82205) **Effective mass and damping of submerged structures.** Dong, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Feb 1979. Contract W-7405-ENG-48. 14p. (CONF-790802—20). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

A number of structures important for safety in nuclear power plants are submerged in water. These include spent fuel storage racks, main pressure relief valve lines, and internal structures in the reactor vessel. Dynamic analyses of such structures must include the force and damping effects of water. A wide variety of modeling assumptions are being used in design analyses, and currently there are no uniform positions by which to judge the adequacy of the assumptions. A study was carried out to establish a technical basis for evaluating the assumptions and to recommend suitable methods to describe the effects of the water. The dimensions and fundamental frequencies of nuclear structures of concern were reviewed to indicate the ranges of interest. Most of the experimental data apply to frequencies of the same order as those of nuclear power structures; however, the test specimens were generally much smaller than actual structures. Structural size was found to have an important influence on the added damping due to water. Consequently, a procedure was developed to extrapolate the experimental damping values to structural sizes of concern. Through this procedure the added damping due to water was found generally low for actual structures, if the structures were treated as single isolated members. The damping ranged from $\leqq$ 0.55% for BWR fuel bundles to $\leqq$ 0.29% for 12.0 in. diameter main stream relief valve lines.

44864 (UCRL—82206) **Soil structure interaction analysis for the US NRC seismic safety margins research program.** Johnson, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21

Feb 1979. Contract W-7405-ENG-48. 12p. (CONF-790802—33). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The soil structure interaction project is described. The initial portion of this task concentrates on defining the state-of-the-art in the analysis of the soil structure interaction phenomenon, an assessment of those aspects of the phenomenon which significantly affect structural response, and recommendations for future development of analytical techniques and their verification. A series of benchmark analytical and test problems for which analytical techniques may be evaluated are also sought. This assessment is to be performed in the context of nuclear power plant structures; i.e., massive stiff structures arranged functionally on a particular site. The best estimate methodology will be utilized to develop transfer functions for the overall systems model. These transfer functions will operate on the free-field ground motion yielding the structural base mat response and selected in-structure response quantities for the particular site being analyzed. The transfer functions will depend on a number of parameters, e.g., soil configuration, soil material properties, frequency of the excitation, structural properties, etc. A limited comparison of alternative methods of analysis including a nonlinear analysis will be performed.

44865 **Core disruptive accident margin seal.** Golden, M.P. (to Dept. of Energy). US Patent 4,135,973. 23 Jan 1979. Filed date 10 Mar 1977. 8p.

PAT-APPL-776,328.

An apparatus for sealing the annulus defined within a substantially cylindrical rotatable riser assembly and plug combination of a nuclear reactor closure head is described. The apparatus comprises an inflatable sealing mechanism disposed in one portion of the riser assembly near the annulus such that upon inflation the sealing mechanism is radially actuated against the other portion of the riser assembly thereby sealing the annulus. The apparatus further comprises a connecting mechanism which places one end of the sealing mechanism in fluid communication with the reactor cover gas so that overpressurization of the reactor cover gas will increase the radial actuation of the sealing mechanism thus enhancing sealing of the annulus.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 44962

MAGNETIC

REFER ALSO TO CITATION(S) 44738

COMPRESSED GAS

REFER ALSO TO CITATION(S) 44867

PUMPED HYDRO

44866 (PB—286666) **Assessment of water quality during deep-water spoil disposal operations, Raccoon Mountain Pumped-Storage Project.** Woosley, L.H. Jr. (Tennessee Valley Authority, Chattanooga (USA). Div. of Environmental Planning). Jul 1978. 34p. NTIS PC A03/MF A01.

The Tennessee Valley Authority (TVA) observed and monitored dredging and disposal operations at the Raccoon Mountain Pumped-Storage Project to determine effects on the physical quality of water. Observations and data indicated that dredging rather than disposal released most of the suspended solids. About 75% of the suspended sediment settled or dispersed within 1.6 km downstream from the disposal area. Although concentrations of suspended solids 4.5 km downstream from the disposal area were 4.0 mg/l higher than those at the upstream control station, downstream turbidity levels had returned to background conditions. TVA regards the dredging and disposal operations as not significantly impacting water quality.

THERMAL

REFER ALSO TO CITATION(S) 44569, 45060, 45077, 45078

44867 (CAES—11) **Cost analysis of packed beds for thermal-energy storage.** Hamilton, N.I. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Dec 1978. Contract EX-76-A-01-2295. 36p. Dep. NTIS, PC A03/MF A01.

A cost analysis of packed beds for thermal-energy storage (TES) in an adiabatic compressed-air-energy storage system is given. Capital costs based on the conceptual design of a TES unit are estimated and their sensitivity to system parameter variation is studied. Two TES conceptual designs were considered for: (a) an excavated cavity, and (b) an abandoned mine. A cost comparison is made between surface-sited and underground TES. A cost model was constructed to study the effect of pebble size, insulation thickness, temperature, storage pressure, storage capacity, and other TES components on the TES capital cost.

44868 (CONF-790515—3) **Large-scale annual-cycle thermal energy storage in aquifers.** Meyer, C.F. (General Electric Co., Santa Barbara, CA (USA). Center for Advanced Studies). Apr 1979. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From International assembly on energy storage; Dubrovnik, Yugoslavia (27 May 1979).

Thermal energy storage in aquifers would solve the mismatch problem which limits the amounts of cogenerated heat that can be used. Heat produced as electricity is generated could be stored during the summer, when electric production tends to peak, to be used during the winter for space heating. Hot tap water, air conditioning, and industrial process heat demands could also be readily satisfied, with high-temperature water carried through pipelines to urban areas many miles away from the cogeneration plant. Potential benefits of aquifier storage in a large district heating/cogeneration system proposed for the Minneapolis—St. Paul urban area in Minnesota (US) are being studied at TEMPO. Reduction of air and water pollution is an important benefit which accompanies conservation of fuels.

44869 **Heat store for low-temperature heat and its uses.** Prenissl, W.; Schleich, J. (to Heilmann und Littmann Bau-A.G., Muenchen (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,652,075/A/. 18 May 1978. 19p. (In German).

A water pond with a floating insulating layer is claimed as storage pond for low-temperature heat. Further claims pertain to the sealing of the pond and to the design of the insulating layer.

BATTERIES

REFER ALSO TO CITATION(S) 44891

44870 (DOE/TIC—10146) **Battery technology: an assessment of the state of the art.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). 27 Mar 1978. Contract EX-76-C-10-3885. 66p. Dep. NTIS, PC A04/MF A01.

As a result of increased interest in battery technology and its potential to aid in meeting the national energy goals, a state-of-the-art battery technology survey was undertaken to provide a data bae for understanding and evaluating the various program efforts and the relative merits of battery technology. It summarized the technology as it is today and estimated the progress likely to be achieved in the next few years. Basic data for each battery type are summarized; a general discussion of other potential battery systems is included. A comparative summary of battery cost and performance is presented. Actual battery capabilities are discussed relative to the general requirements of electric utility load leveling and transportation applications. The current status of the scarce materials and environmental and safety problems related to battery technology are presented. The overall status of the current R & D programs and expected progress toward commercialization is given, and the roles of competing technologies in two major markets for battery technology are discussed. General observations, conclusions, and recommendations are summarized. 9 figures, 25 tables. (RWR)

DESIGN AND DEVELOPMENT

44871 (ANL—79-1) **Engineering development of lithium/metal sulfide battery technology for vehicle propulsion. Summary report, October 1977—September 1978.** Barney, D.L.; Chilenskas, A.A.; DeLuca, W.H.; Hayes, E.R.; Hornstra, F.; Farahat, M.K.; Graae, J.A.E.; Box, S. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 35p. Dep. NTIS, PC A03/MF A01.

The research, development, and management activities done in preparation for in-vehicle testing of engineering-scale lithium/metal sulfide batteries are described. These activities were carried out at Argonne National Laboratory (ANL) from October 1977 to September 1978. Over the past year, lead—acid batteries were tested both in the laboratory and in a Renault automobile. The data

obtained from these tests will be used to assess the performance of lithium/metal sulfide batteries. Testing of a 40 kWh lithium/metal sulfide battery in a vehicle is planned for early 1979. The equipment needed to evaluate the performance of this battery was designed and fabricated. Testing of this equipment is expected to begin at the end of 1978. In order to carry out the above in-vehicle test, the lithium/metal sulfide battery must have a thermally efficient case and a charger. Construction of such a case is in progress. A portable charger/equalizer that has the capability of charging up to six lithium/metal sulfide cells was fabricated. 12 figures, 8 tables.

44872 (SAND—79-0814) **Development of a lithium alloy/iron disulfide, 60-minute primary thermal battery.** Quinn, R.K.; Baldwin, A.R.; Armijo, J.R.; Neiswander, P.G.; Zurawski, D.E. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 41p. Dep. NTIS, PC A03/MF A01.

The results of a Sandia Laboratories program to develop a long-life primary thermal battery are presented. The feasibility of a 50- to 60-minute, 1-ampere, 28-volt, 400-cm^3 primary battery is demonstrated under ambient conditions. The active cell components, Li(Si)/LiCl, KCl/FeS_2, showed the best results of the electrochemical systems studied. The cell electrochemistry gave reproducible battery results with no observed complications from side reactions. Results at high current densities (up to ~ 1,000 mA/cm^2) indicated the possibility of power applications for primary battery systems. Also, high current loads late in activated life, after a steady-stage, low-current density discharge, resulted in little polarizability in this system. 14 figures, 7 tables.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 44877

44873 (AD-A—060456) **Lead calcium battery cell servicing and charging problems and procedures. Technical report.** Bennett, T.A. (Electronics Engineering Group (1842nd), Scott AFB, IL (USA)). 30 Sep 1978. 10p. NTIS PC A02/MF A01.

Lead calcium battery cell charging problems were experienced in the field. Record data was submitted for review and recommendations. This report provides an analysis of the problem and recommends servicing and initial charging procedures.

44874 **Computation of heat evolution in a sealed nickel—hydrogen battery.** Tsenter, B.I.;Dankova, I.S. *Elektrokhimiya;* **14**: No. 8, 1250-1253(1978). (In Russian).

The thermodynamic parameters of a nickel—hydrogen and nickel—cadmium battery are examined in order the compute the amount of heat evolved when the battery is charged at various currents. Mathematical expressions are derived for heat evolution resulting from oxygen ionization and battery charging. 3 references, 1 figure, 1 table.

44875 (N—78-33539) **Cycle life test. Progress report.** Harkness, J.D. (Naval Weapons Support Center, Crane, IN (USA)). 10 Mar 1977. 215p. NTIS PC A10/MF A01.

Statistical information concerning cell performance characteristics and limitations of secondary spacecraft cells is presented. Weaknesses in cell design as well as battery weaknesses encountered in various satellite programs are reported. Emphasis is placed on improving the reliability of space batteries.

MATERIALS, COMPONENTS, AND AUXILIARIES

44876 (CONF-790526—2) **Development of porous sintered-ceramic separators for application in a Li—Al/LiCl—KCl/FeS battery.** Bandyopadhyay, G.; Dusek, J.T.; Galvin, T.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From 4. international meeting on modern ceramic technologies; St Vincent, Italy (28 May 1979).

The procedure for fabrication of porous sintered-ceramic separators and the technical feasibility of using such separators in Li—Al/molten LiCl—KCl/FeS battery cells were investigated. Processing techniques were developed to fabricate ~ 1.5 to 2.5 mm thick, ~ 35 to 60% porous, flat, sintered Y_2O_3 and MgO separator plates with sufficient strength to allow handling prior to and during cell assembly. These seperators performed successfully in laboratory-scale cells for up to ~ 2000 h and 283 cycles; thus the concept of a sintered separator is viable for Li—Al/FeS batteries. The particularly attractive features of these separators are potentially low cost, prefabricated form that allows easy cell assembly, and small pore size (average diameter 0.5 to 1.0 μm), which provides good particle retention. The test results from the sintered-separator cells indicate that Y_2O_3 is probably unsuitable for long-term performance in Li—Al/FeS cells because of its reaction with the positive active material. This is in agreement with the recently reported data on cells with Y_2O_3 felt and powder separators. Sintered MgO separators, however, showed good chemical and mechanical stability in the cell environment. 9 figures, 1 table.

44877 (DOE/TIC—10098) **Development and evaluation of materials for high temperature lithium/sulfur rechargeable batteries.** Swaroop, R.B.; Smaga, J.A.; Battles, J.E. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

Electrochemical energy storage is being achieved by the development of high-temperature rechargeable batteries. Li—Al/FeS secondary batteries are being developed for use of power sources for electrical vehicles and as stationary energy storage devices for load-leveling on electric utilities. This battery could be recharged by the electricity produced via photovoltaic solar energy, nuclear energy, or coal-steam turbines. The high temperature corrosiveness of the active materials and molten electrolyte places severe restriction on the type of materials that can be used for current collectors, separators, and feedthrough insulators. Out-of-cell and in-cell tests are being conducted to identify the materials that are compatible with this cell environment. The corrosion test procedures, the nature and kinetics of the corrosion reactions, and the development and testing of electrode separators are discussed.

ENERGY MANAGEMENT AND POLICY

44878 (DOE/PR—0027) **Procurement regulations handbook: source evaluation board.** (Department of Energy, Washington, DC (USA). Office of Procurement and Contracts Management). 1979. 67p. Dep. NTIS, PC A04/MF A01.

This Handbook is published to provide a compilation of significant policies and procedures applicable to the source evaluation and selection process. It provides guidance to source selection officials, source evaluation boards (SEBs), and others who will participate in the preparation of requests for proposals, evaluation of proposals, preparation of SEB reports, presentations to selection officials, and selection of offerors. The SEB process is a process utilized by the DOE to evaluate proposals submitted in response to formal requests for proposals above a specified dollar amount. The objectives of the process are to: (1) assure efficient and effective expenditure of Government funds; (2) optimize the opportunity for attainment of program objectives; (3) obtain adequate and effective competition in the acquisition of goods and services; (4) assure impartial, equitable, and thorough evaluation of proposals and other informaion received; and (5) provide necessary data to the source selection official to permit the selection of the best offer. The provisions of this Handbook will be used in appropriate major procurements as provided for in DOE Directives and Procurement Regulations and for other situations as determined by the Secretary, Deputy Secretary, or Under Secretary.

44879 (PB—284277) **Improvements needed in the Department of Energy's efforts to develop a Financial Reporting System.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 31 Jul 1978. 9p. NTIS PC A02/MF A01.

The Department of Energy is developing a comprehensive energy information system. The Financial Reporting System is intended to compile the information required under several energy mandates, including the Energy Policy and Conservation Act. This report makes several recommendations to the Secretary of Energy regarding shortcomings in the Department's efforts.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 44886, 44923

44880 (BNL—25599) **Why should energy models form a crucial policy input in an uncertain political world.** Marcuse, W. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 7p. (CONF-7805106—2). Dep. NTIS, PC A02/MF A01.

From Canadian energy policy modeling conference; North Vancouver, Canada (18 May 1978).

Models have been and are being used by the U.S. Department of Energy to provide inputs into the decision process. The question is often asked as to the accuracy of their forecasts and the methods used for validation. It is asserted that energy models can not be predictive, and that validation based on experience with models of physical systems is inappropriate. Asking the question as to the accuracy or validity of an energy system model is not useful. The usefulness of energy models for policy analysis or technology assessment lies in the comparative results generated for alternative scenarios, initiatives, and actions.

44881 (DOE/TIC—10586) **Task 1. Draft report on critical factors and theoretical structure.** (Synergy, Inc., Washington, DC (USA)). 1 Apr 1977. 14p. Dep. NTIS, PC A02/MF A01.

This draft report presents the results of Synergy's investigation on the development of an interface between the Regional Energy, Activity and Demographic (READ) Model and the Structural Demand (SD) Model. As specified in the contract, this report aims at identifying, summarizing, and analyzing critical factors and theoretical structure of integrating the READ and SD Models. It addresses compatibility and requirements, software development, regional structure and other factors deemed critical in the course of consultation with FEA staff. The report is comprised of three parts. Part One presents an outline of the present status of the READ and SD Models as they relate to Synergy's interface task. This information is important as it will affect the proposed methodological construct. Part Two identifies and analyzes the critical factors and proposes a feasible structure for integrating the two models. Other issues as compatibility of the models, software development, and new data and equation requirements are also treated in this part. The last part offers concluding remarks.

44882 (LA—7772-MS) **Sensitivity analysis of large computer models: a case study of the COAL2 national energy model.** Ford, A.; Moore, G.H.; McKay, M.D. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 40p. Dep. NTIS, PC A03/MF A01.

Although both model builders and users agree that sensitivity testing is an important part of the modeling process, a paucity of formal techniques has led many modelers to conclude their studies with only minimal sensitivity analysis. The purpose of this report is to illustrate the use of recently developed techniques that make sensitivity testing less difficult. In this illustration, the sensitivity of the COAL2 energy model is examined by using a systematic sampling plan on 72 input parameters. The behavior of 13 output variables over the time period from 1975 to 2010 is collected for samples with as many as 100 runs. This vast amount of output information is analyzed through formal and informal methods. The formal approach makes use of partial correlation coefficients filtered over time to select key input parameters. The informal analysis makes use of extensive display options to examine the model performance over a wide range of input conditions. It is concluded that the sensitivity procedures illustrated in the COAL2 case study could be used to examine a variety of models in use at the Department of Energy. An important prerequisite for easy application of the procedures, however, is clear and thorough documentation.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 44262, 44321, 44322, 44323, 44880, 44889, 44890, 44901, 44909, 44915, 44929, 44976, 44979, 44993

44883 **How energy affects the economy.** Askin, A.B. (ed.). Lexington, MA; Lexington Books (1978). 141p.

The 10 papers presented in this book are the direct outgrowth of FEA analyses or spin-offs of such analyses by contributors' research efforts on the energy problem and the economics of energy. The papers are: The dilemmas of setting energy policy, A. Bradley Askin; The energy crisis and the US economy, 1973—1975, David E. Serot; Changing energy consumption patterns in US manufacturing, William G. Rice and Eugene Rossidivito; The impact of higher oil prices on economic growth in the industrial economies, Peter Morici, Jr.; Effects of the Energy Policy and Conservation Act on Energy Independence and the National Economy, A. Bradley Askin and Richard L. Farman; Simulating alternative energy scenarios with the Wharton long-term model of the US economy, Arthur J. Malloy; Macroeconomic simulations of alternative energy scenarios with the DRI model, Richard L. Farman and Gerald L. Legace; Reconciling alternative forecasts of energy and the economy, A. Bradley Askin; Alternative energy futures and the structure of employment in the US economy, Ronald F. Earley and Malek M. Mohtadi; and Regional economic implications of national energy scenarios, A. David Sandoval and Robert M. Schnapp.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 44248, 44478, 44885, 44890, 44913, 44930, 45342, 45343, 45352, 45367

44884 (PB—285657) **Proposed coastal management program for the State of North Carolina. Final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Aug 1978. 303p. NTIS PC A14/MF A01.

Approval and implementation of the program will allow the State to better coordinate and more effectively implement existing State authorities for management of its coastal zone. The state will condition, restrict, or prohibit land and water uses in some parts of the North Carolina coast, while encouraging development in other parts. The impacts of the North Carolina Coastal Plan will be generally beneficial, although there may be some adverse, short-term economic impacts on coastal users, and the program will entail irreversible commitment of some coastal resources. The North Carolina Coastal Plan will produce positive and negative impacts.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 45379

44885 (ORNL/OEPA—8) **Potential institutional conflicts in the implementation of the Resource Conservation and Recovery Act and their impacts on the Department of Energy: background information.** Carnes, S.; Tevepaugh, C.; Young, G.; DeVault, R.C. (Oak Ridge National Lab., TN (USA)). Feb 1979. Contract W-7405-ENG-26. 47p. Dep. NTIS, PC A03/MF A01.

The Resource Conservation and Recovery Act (RCRA) of 1976 is examined with respect to its implementation by EPA and its impacts on DOE. Generic implementation problems are identified, and implementation of the act is assessed from the perspectives of Congress, the EPA, the courts, and the states. The major findings of this study are: the short-term implementation scenario (1978—1983) is likely to be dominated by state and local political processes and regulatory activities; RCRA implementation is likely to be interpreted and guided by litigation; the resource and energy recovery aspects of RCRA (Subtitle E) are being ignored relative to the hazardous waste aspects of RCRA (Subtitle C); expanded public participation under RCRA is delaying the implementation of the act and may lead to increased litigation; and the long-term implementation scenario (after 1983) is difficult to project due to present uncertainty and necessary reauthorization by Congress in 1979. 30 references.

44886 (PB—288154) **A mathematical model for simulating water demand-supply and energy uses for the state of Pennsylvania. Master's thesis.** Martinez, H.H. (Pennsylvania State Univ., University Park (USA)). Mar 1978. Contract DI-14-34-0001-7080. 132p. NTIS PC A07/MF A01.

A linear Flow Model, as a mathematical tool, can be used to simulate different situations of water/energy supply-demand response to energy demand changes in order to make easier the planning and control of energy production in some optimal mode. Preliminary models of water supply-demand in Pennsylvania were established using Linear Flow Model methodology and use of these models to depict the operation of the Pennsylvania water/energy system was illustrated.

44887 (N—78-29535) **Soyuz 22: new contribution to earth study from space.** Vedeshin, L.A.; Ivanov, V.V.; Sulidi-kondratyev, Y.D. Translated from *Priroda (Moscow);* No. 3, 20-23(Mar 1977). 9p. NTIS PC A02/MF A01.

The mission of space flight Soyuz-22 was to develop new and improved methods and means for finding tthe Earth's natural resources from outer space to aid the economy. With the help of the new multispectral space camera, MKF-6, the cosmonauts were able to photograph selected areas of U.S.S.R. and the German Democratic Republic in 4 visible and 2 infrared regions of the spectrum. The MKF-6 can simultaneously photograph areas in 6 spectral regions and register both the natural electromagnetic radiation of surface objects and the solar radiation reflected by them.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 44891

44888 (PB—284604) **Adoption and utilization of urban technology: A decision-making study (executive summary). Part 4. Final report.** Lambright, W.H. (Syracuse Research Corp., NY (USA)). Sep 1977. 58p. NTIS PC A04/MF A01.

In recent years, the problem of technology transfer to domestics social needs has become one of the more controversial and nettlesome issues in the relations between the Federal Government and cities. As funding for federal research and development has increased for domestic-oriented agencies such as the Departments of Housing and Urban Development, Transportation, Justice, and Energy, it has become clear that spending money for RandD does

not guarantee innovation. The concern of this report is with the specific issues related to technology transfer to the city, i.e., urban public services.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 44740, 44797

44889 Mitigating community impacts of energy development: some examples for coal and nuclear generating plants in the U.S. Peelle, E. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **44**: No. 1, 132-140(Jun 1979).

Three mitigation plans aimed at internalizing community-level social costs are examined at the Tennessee Valley Authority four-unit nuclear plant in Hartsville, Tennessee; the Puget Sound Power and Light two-unit nuclear plant in Skagit, Washington; and the Missouri Basin Power Project three-unit coal plant in Wheatland, Wyoming. Viewed as new institutional responses to social impact mitigation planning, these plans are analyzed in terms of their origins, scope, goals, local participation, financing, and costs. The significance of the plans derives from: (1) their pioneer status; (2) their similarity of scope despite highly diverse regulatory environments; and (3) their custom tailoring to local circumstances.

44890 Nuclear wastes: a problem of perspective. Williams, I.G.K. *Sci. Public Policy;* **6**: No. 2, 134-142(Apr 1979).

Presented at the international conference on the nuclear fuel cycle, London, 28 Sep 1978.

A major contribution from nuclear power is indispensable for most countries. It is for society to determine how much it is willing to pay to reduce the potential hazards and to weigh the residual risks against the consequences of dispensing with the use of nuclear energy. Public concern points up a need to disseminate more objective information in a language that ordinary people can understand, particularly in relation to radioactive waste management. The main issue concerns disposal of high-level wastes from reprocessing or of the once-through spent fuel. The degree of risk is not merely the presence in the environment of dangerous wastes but the likelihood of exposure to them. The author notes there are plenty of non-radioactive industrial wastes with the characteristics of high toxicity and long-term persistence that require even more vigilant isolation. Public sensitivity will always be a healthy antidote to any tendency towards complacency and will remain an element in ensuring that exemplary standards of safety and consideration for the environment will continue to be the hallmark of the nuclear industry.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 44867, 44870, 45002

44891 Superbatteries: a progress report. Birk, J.R. (Electric Power Research Inst., Palo Alto, CA); Klunder, K.; Smith, J.C. *IEEE Spectrum;* **16**: No. 3, 49-55(Mar 1979).

New developments in battery technology that will increase energy density at lower cost while retaining the reliability and efficiency of the lead-acid battery may eventually allow batteries to compete with and replace oil and gas fuels for transportation and provide electric power storage by utilities for load leveling. Research on the new superbatteries is typified by the sodium-sulfur concept, which is described and compared to the lead-acid type. Successful commercialization must first overcome the high development and demonstration costs. Cooperation between suppliers, utilities, and the government should continue to offer the necessary innovative and cost-sharing environment necessary for the introduction of a new technology.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 44868, 45019

44892 (CONF-7806118—) **Cogeneration opportunities.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). 1978. 268p. Dep. NTIS, PC A12/MF A01.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

This is a collection of 13 unedited papers presented at the symposium. A separate abstract was prepared for each paper; complete papers from all of the presenters were not available at the time of printing. In addition to the 13 papers, questions and answers from panel discussions are included also.

44893 (CONF-7806118—, pp 4-20) **Key to cogeneration development: a cooperative industry-government effort.** Bos, P.G. 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

The author points out the significant energy savings potential from cogeneration. He reviews how cogeneration can serve the interests of industry, electric utilities, and government. He also discusses the key technical, economic, regulatory, and institutional constraints on cogeneration, because he believes their significance is not adequately understood at present. The key actions needed by each party of interest to support the cooperative effort that is required are summarized.

44894 (CONF-7806118—, pp 25-48) **Evaluation of industrial cogeneration options.** Limaye, D.R. (Mathtech, Inc., Princeton, NJ). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

This paper presents an overview of the technical, operational, and institutional options available to industrial firms and utilities in the area of cogeneration of thermal and electric energy. A brief review of the available technologies is presented, and the advantages and disadvantages of some of the available technologies are summarized. The issues related to matching or decoupling of electric and thermal load profiles are discussed, and the major constraints to the installation of cogeneration plants are identified. 24 references.

44895 (CONF-7806118—, pp 50-65) **Industrial cogeneration planning at DOE.** Cowles, R.L. (Department of Energy, Washington, DC). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

The author sets out the DOE view of industrial cogeneration in perspective, outlines the broad objectives of the National Energy Plan, and relates industrial cogeneration to those objectives. Then some industrial cogeneration activities that have been completed, are under way, or have been contemplated by DOE are described. The objectives of the industrial cogeneration research, development, and demonstration program are to develop optimized inter-industrial/utility cogeneration projects, minimize the long-range requirements for gas and high distillates, develop improved conversion technologies, and accelerate the introduction of industrial cogeneration. The strategy is to sponsor research and development in advanced technology, conduct in-depth industry cogeneration optimization studies, and co-fund cogeneration system development and evaluation projects. A Program Opportunity Notice (PON) for a number of demonstration projects has been completed to provide demonstration of advanced cogeneration systems in several industries. Concentration will be placed on the cement, chemicals, petroleum refining, glass, paper, food processing, and textile sectors. Many other projects are also described. In the non-RD and D area, DOE plans to co-fund a study with a highly populated, industralized state to develop a statewide cogeneration implementation plan. The study would identify potential cogeneration candidates including community system types (hospitals, campuses, commercial and residential complexes). (MCW)

44896 (CONF-7806118—, pp 66-81) **Overview of advanced cogeneration activities. Cogeneration technology alternatives study.** Lister, E. (Department of Energy, Washington, DC). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

The objectives of the advanced cogeneration activities are to develop and demonstrate cogeneration systems that feature alternate fuel capability and optimum engine/process match. The advanced cogeneration systems program includes prototype systems assessments; direct fired heat engines (gas turbines and diesels); and externally fired heat engines (Stirlings and gas turbines). The U.S. Department of Energy Cogeneration Technology Alternatives Study (CTAS) is reviewed. Candidate cogeneration configuration options include use of auxiliary furnace, import or export of electricity, auxiliary heat pump, and thermal storage. The CTAS program, its guidelines, features, etc., are identified. This report only included outline-type information. (MCW)

44897 (CONF-7806118—, pp 83-106) **Facts, fables, and frustrations of cogeneration.** Campbell, H.A. 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

The reasons for the popularity of cogeneration at present are conservation, help conversion to coal, force cooperation among utilities and industry, halt siting of nuclear and other generating plants, and good politics, the author says. Vulcan Materials Compa-

ny has a chemical division that produces chlorine, caustic, and chlorinated solvents. Two of the plants are located at Wichita, Kansas and Geismar, Louisiana. The Wichita and Geismar plants have energy demands of around 70,000 kW and 300,000 pounds per hour of steam. The author reveals the experiences of Vulcan in trying to develop cogeneration at these plants. A Geismar coal-fired plant, if it comes to fruition, will have taken nine years. A Wichita gas-turbine cogeneration plant could be completed in two years. (MCW)

44898 (CONF-7806118—, pp 108-116) **Southern California Edison Company's exprience with cogeneration.** Blake, A.J. (Southern California Edison Co., Rosemead). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

One means to defer construction of expensive new generating plants as well as conserve natural resources is through a parallel generation arrangement which can include cogeneration. The terms parallel and cogeneration are often interchanged. Parallel generation is the operation of an Edison retail customer's generator while connected to the Edison system. Parallel generation also includes cogeneration which is the recovery by Edison and/or one of its retail customers of waste energy from one process, and its utilization in a second process, which includes the generation of electrical energy. In the late 60's, Edison began working with Garden State Paper Company to build its first dual-purpose generating facility. This facility has been supplying both electric power and steam for this paper company since 1967. The next experience with cogeneration occurred during 1976 when Stauffer Chemical Company in the city of Carson cranked up its own 3.5-MW waste-heat system. Stauffer's energy-conservation system harnesses waste heat from a sulfuric acid production process to produce steam for the turbine generators. Since these two projects, Edison has intensified its cogeneration efforts and has identified and contacted customers with 414 MW of cogeneration potential. (MCW)

44899 (CONF-7806118—, pp 118-124) **Maximizing byproduct energy.** McConnell, J.E. (ASEA, Inc., White Plains, NY). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

When the opportunity exists, combining electrical power generation with thermal energy supply systems provides economical means of satisfying energy demands for energy-intensive heavy industries and district-heating applications. By eliminating a large quantity of low-level heat which is normally rejected to the condenser in the steam cycle, and utilizing it at a suitably higher level for industrial process or space heating, improved utilization of energy resources can be achieved. Byproduct energy is the kWh produced in this manner and which can help relieve generating electrical power by lower-efficient means or through the use of power-generation cycles that require premium-quality and increasingly scarce fuels. The methods presented are based on practical experiences which have been successfully applied world-wide and which draw heavily upon established Scandinavian practices for improving heat-drop utilization. The paper explains the techniques that will help maximize the return-on-investment for backpressure and extraction-type turbine generators.

44900 (CONF-7806118—, pp 152-167) **New name for a proven technology.** Wilson, W.B. 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

Following a brief overview of industrial energy supply alternatives, a history of cogeneration is given. Some joint utility-industrial arrangements listed are Gulf States Utilities which has supplied both process steam and power to co-located industrials in the Baton Rouge, LA area for 50 years; Houston Lighting and Power which has supplied steam to Champion Paper in Pasadena, Texas for decades; and Pacific Gas and Electric which has supplied process steam to Standard Oil of California for about 30 years. The California Public Utilities Commission and other regulatory agencies are encouraging utilities to seek out opportunities for cogeneration with industrials. A number of industrials are now considering some joint ventures with a large co-located cogenerating plant supplying power for a number of industrial plants such as in Texas City, Texas and Geismer, Louisiana. The city of Hempstead and the Long Island Lighting Company are building a plant with capability to generate about 40 MW, utilizing municipal wastes. The privately owned steam-generating facility called RESCO in Saugus, Massachusetts supplies about 200,000 lbs/h of steam for cogeneration in GE's Lynn River Works. The following are discussed: efficiency of energy utilization, capital investment and operating costs for cogeneration, effect of future energy costs, combined steam-combustion gas-turbine systems, and incentives for energy-conserving turbine systems. (MCW)

44901 (CONF-7806118—, pp 169-189) **Cogeneration process economics.** Comtois, W.H. (Westinghouse Electric Corp., Pittsburgh, PA). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

The physical aspects of cogeneration plants are first discussed (the steam power plant, the process steam plant, the cogeneration plant, the back-pressure method, the condensing-extraction method, the combined-cycle plant, and the cogeneration advantage). There is a multiplicity of methods to join power and steam production facilities into a cogeneration unit, and there is also a multiplicity of methods for dealing with cogeneration savings. The method chosen for further analysis here is called the OSW Method because it was first proposed in the former Office of Saline Water for dealing with combination power/desalting plant economics. One product (power or the steam) is considered the byproduct. To apply this method, electric power is assumed to be the primary product and a power-only plant is designed (for cost purposes only) of such capacity as is desired for that product. Then a cogeneration plant with that same electric production capacity plus the quantity of process steam to be produced is designed and similarly costed. The analysis is completed and results are shown graphically. The monetary savings due to cogeneration are not derivable from the analysis presented. (MCW)

44902 (CONF-7806118—, pp 191-203) **Cogeneration systems.** Solt, J.C. (SOLAR/International Harvester, San Diego, CA). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

This paper traces the development of cogeneration systems using gas turbines as a principal prime mover and discusses the shortcomings of some early applications. The effect of changing markets and economic conditions is evaluated and specific examples are presented to illustrate the increasingly favorable climate for cogeneration-system applications in today's energy-conscious society.

44903 (CONF-7806118—, pp 205-230) **Applications of cogeneration.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

Two applications of cogeneration are described. The first application presented is at Clark University in Worcester, Massachusetts and is part of the DOE-sponsored Integrated Community Energy System Program. The cogeneration system is based upon a diesel supplying electricity to the university and the utility grid and steam to the university. Part of the electricity generated is excess and is sold to the utility. The diesel engine generates heat to supply the university's thermal requirements from three sources: (1) generating 125 psig in a waste heat boiler, (2) the engine jacket water cooling producing steam at 15 psig, and (3) the aftercooler employed as an economizer. In the second application, electricity is generated from the waste heat of a cement kiln. The waste flue gases from the cement kiln flow through a heat recovery boiler producing steam. The steam generates electricity in a condensing turbine.

44904 (CONF-7806118—, pp 232-238) **One utility's experience with cogeneration.** Hale, M.R. (San Diego Gas and Electric Co., CA). 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

Applied Energy, Inc., a wholly owned subsidiary of San Diego Gas and Electric Company, is involved in the commercial operation of several central chilled-water and steam plants. It began operation with a central chilled-water plant in the Rancho Bernardo area of San Diego. The second project was a cogeneration plant serving the entire steam requirements at the Naval Training Center and the Marine Corp Recruit Depot. A central chilled-water plant providing air conditioning to several downtown San Diego buildings was the third plant on-line. The next plant to begin operation was a cogeneration plant serving steam to the 32nd Street Naval Station. A steam plant serving the Naval Air Station, North Island was the fifth plant to be placed in service. A steam plant serving Rohr Industries in Chula Vista is the latest project. All the plants consist of a gas-turbine-driven electric generator with a heat-recovery boiler using the turbine exhaust to produce steam. This has become known as a topping-cycle cogeneration plant. A package boiler is used for a standby and during times when steam demand is too low to economically use the heat-recovery unit.

44905 (CONF-7806118—, pp 239-246) **Lowering institutional barriers to cogeneration.** Siedel, M.R. 1978.

From Cogeneration opportunities; St Louis, MO, USA (6 Jun 1978).

From the standpoint of a regulator concerned with utilities, the author points out that cogeneration has to be done extensively by utilities; and if that is to happen, commissions have to allow and encourage it. Society's scarce resources include not just energy but manpower, quality of life, the environment, capital assets, etc.; in essence, the real worth of whatever has been built up, which must be put to its best use, rather than replacing it prematurely or wasting it. Money is only the means by which different scarce resources are traded. As long as the government confuses the way the price system operates (for example, by imposing distorted prices on resources) the price signals may be wrong, the author says. Government planners have to pay attention to the real value of resources, if they are to be allocated correctly. The author believes that right now coal is probably somewhat overpriced in terms of the cost of using it, given existing environmental restrictions and gas, oil, and electricity are all dramatically underpriced compared to the value society places on their resource requirements. He further states and describes that electricity prices today do not exceed those of 10 years ago in constant-dollar terms. He then discusses the reasons that there is a large opportunity for cogeneration which needs developing, but it is essential that it be the utilities that do most of it even though the National Energy Act gives all the incentives to industry. He does observe, however, that it is up to the industries to talk to the utilities, and the utilities and industries that are interested to ask for rate relief through the special provisions as may be needed to make such an opportunity profitable. (MCW)

CONSERVATION

REFER ALSO TO CITATION(S) 44893, 44894, 44895, 44900, 44962, 44980, 44994, 44997, 45003, 45004, 45006, 45007, 45008, 45009, 45010

44906 (DOE/TIC—10594) **Federal Lighting Efficiency Program (FLEP). Volume 1. Study report.** (RW Associates, Inc., Vero Beach, FL (USA)). 6 May 1977. 77p. Dep. NTIS, PC A05/MF A01.

The study was conducted to develop a 10-year Federal Lighting Efficiency Program. It consisted of four analytical tasks: conduct a survey of recent lighting research and development;conduct a cost/benefit evaluation of energy-conserving options available as a result of the lighting research; develop a cost-effective Federal Lighting Efficiency Program plan based on the study results; and identify commercialization barriers that may exist that prevent widespread utilization of the energy-conserving options. The results are summarized in this volume.

44907 (DOE/TIC—10595) **Federal Lighting Efficiency Program (FLEP). Volume II. Recommended program plan.** (RW Associates, Inc., Vero Beach, FL (USA)). 6 May 1977. 43p. Dep. NTIS, PC A03/MF A01.

The purpose of the Federal Lighting Efficiency Plan is to develop a 10-year program to improve the efficiency of lighting in the Federal government and to carry appropriate public educations programs to encourage lighting efficiency improvements to the private sector. The authority to implement such a program is contained in the Energy Policy and Conservation Act. This volume investigates lighting efficiency barriers, and presents near-term, mid-term, and long-range program recommendations.

44908 (DOE/TIC—10816) **Analysis of effectiveness of implementation strategies.** Savadelis, J.; Hilton, R.; Ross, J.; Townsend, G.; Kinst, R.; Randall, W.; Said, M.; Wegner, R. (TRW Systems and Energy, Washington, DC (USA)). 24 Oct 1977. 184p. Dep. NTIS, PC A09/MF A01.

A program for State Energy Conservation Plans was established and designed to promote the conservation of energy and reduce the rate of growth of energy demand. This study collects information aimed at evaluating the effectiveness of each implementation strategy. The program measures submitted by the states were classified within one of five sectors: transportation, industrial/agricultural, buildings, utilities, or miscellaneous. The characteristics of and unique constraints to energy conservation are detailed for each sector. Within each sector, information provided for each program measure included: distribution of implementation strategies, definition of compliance, average compliance, most common implementation strategy, most effective implementation strategy, states that submitted programs which did not employ the most common strategy, potentially exemplary projects, and innovative and promising strategies or program measures. Educational measures appeared to be the most commonly employed strategy. The program is voluntary; however, in order for a state to be eligible for financial assistance, it must adhere to the program guidelines which include: submitting programs on 5 required measures (thermal and light standards; carpool, vanpool, or mass transit; right-turn-on-red; and procurement practices) and achieving 5% savings of 1980 consumption. (MCW)

44909 (NP—23796) **Operation Bootstrap: renewable and efficient energy for New York State.** Haley, D. (New York State Legislative Commission on Energy Systems, Albany (USA)). 1977. 110p. NTIS, PC A06/MF A01.

Operation Bootstrap is a self-help program designed to make sure that the vast sums spent on energy in New York state are spent to the extent sensible and possible within New York, creating jobs and stimulating business. The theme of the report is how much can be accomplished and how quickly by conservation and renewable energy systems applicable to New York. Following a chapter to begin Part I discussing energy independence, a discussion on energy conservation is presented. The following are then presented: Efficiency/Conservation in Electricity; Bootstrap Technologies (inertial storage or flywheels, wind energy, bioconversion, solar collectors and cells, new patterns with solar energy, recycling of wastes); Nuclear Energy; Power Transmission; Alternatives to the Electric Distribution System; The Power Authority; The Safe Energy Act; Phantom Taxes in Your Electric Bill; Empire State Power Resources Inc.; Natural Gas; Proposed Gas Rate Surcharge for Gas Exploration; Who Owns What; and The Status Quo. Part II, Jobs and Energy, is an analysis of the employment-creation potential of the Operation Bootstrap approach. (MCW)

44910 (PB—286973) **Evaluation of economic benefits of resource conservation. Final report.** Anderson, R.C. (Environmental Law Inst., Washington, DC (USA)). Sep 1978. 51p. NTIS PC A04/MF A01.

The forces that determine prices of non-renewable natural resources are an important consideration in an evaluation of the social desirability of conservation through recycling. If prevailing market prices accord conservation benefits a value less than their true value to society, the prices are suboptimal and the solution may require governmental support of resource recovery and recycling. A comprehensive review of the literature on natural resource economics reveals that numerous external forces can cause divergencies between the socially optimal prices and the prices that are actually determined in the market place. The forces act in varying directions and with varying intensities over time. It is, however, difficult to establish with any degree of precision the magnitude or even the direction of bias given to the prices acting on supply and demand. Moreover, the socially optimal level of resource conservation is likely to be viewed differently by individuals of different generations.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 44883, 44923

44911 (HCP/R4024—15) **Energy demands, 1972—2000.** Babcock, W.H.; Siegel, S.B.; Swanson, C.A. (PRC Energy Analysis Co., McLean, VA (USA)). May 1978. Contract EG-77-C-01-4024. 206p. Dep. NTIS, PC A10/MF A01.

A revised and updated compilation is presented of the major post-embargo energy projections currently available. The purpose of this volume is to provide a ready reference to existing projections with provisions to include new projections as they become available. The individual projections are reported as they are published. No attempts are made to alter the data to account for differences in forecasting techniques or assumptions employed. Comparisons of all the projections are provided. In addition to total energy projections summaries, comparisions are made on the basis of (1) government, (2) non-government, and (3) FEA and ERDA projections. The first group contains those projections done by U.S. government agencies; the second contains those projections done by private firms, industry groups, and private individuals; the third includes high, medium, and low projections from the FEA and ERDA studies. Summary projections of the contributions made by Coal, Petroleum, Natural Gas, Nuclear and Solar energy are also presented. Identification of the various projections is consistent throughout the report.

44912 **Historical energy statistics. Volume 3.** Itami, R. Helena, MT; Montana Department of Natural Resources and Conservation (1979). 73p. (NP—23795). Montana State Library, Helena, MT.

Montana historical energy statistics are compiled for energy supplies; much data cover 1950 to 1977, but 1977 data are detailed. Total production of energy in Montana in 1977 amounted to 733 trillion Btus, an increase of 1% over 1976. Of the energy produced in 1977, coal accounted for 64.7%, crude oil 25%, natural gas 6.5%, and hydroelectric generation 3.8%. The amount of energy consumed was 284 trillion Btus, an increase of 2% over 1976. Detailed data are provided for electricity, coal, natural gas, crude petroleum and petroleum products, and uranium. Data are tabulated for energy consumption by sectors. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 44290, 44468, 44878, 44880, 44885, 44906, 44907, 44908, 44930, 44988, 45002

44913 (DOE/EIS—0038) **Fuel Use Act. Final environmental impact statement.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Apr 1979. 589p. Dep. NTIS, E05/MF E05.

The major environmental impacts and adverse effects discussed in this environmental impact statement (EIS) are those which would result from implementation of the regulations for enacting the coal and alternate fuels use program which has been authorized by the Powerplant and Industrial Fuel Use Act of 1978 (FUA) Pub. L. 95-620. This impact statement deals with overall program and regional impacts rather than site-specific impacts and is predicated on the assumption that coal will be the primary fuel substituted for oil and natural gas in the short term (until 1990). Site-specific environmental impacts will be addressed in subsequent NEPA compliance documents, for exemption petitions and by other federal, state, and local permitting agencies.

44914 (PB—284703) **The energy dilemma: A challenge for Maryland. Proceedings Maryland General Assembly/AISLE Conference, held at Annapolis, Maryland on December 1-3, 1977.** Miller, M.H.; Willis, D.C.; Musk, E.D. (Maryland Dept. of Legislative Reference, Annapolis (USA)). Jul 1978. 151p. NTIS PC A08/MF A01.

Topic areas cover: Energy resources management; National Energy Act - application to Maryland; Energy conservation in buildings and homes; Water resources management - energy implications; Energy and air quality management; Alternate energy resources.

44915 (UCRL—15004) **Political economy of energy regulation: a classification of policies.** Balderston, F.E. (California Univ., Berkeley (USA). Center for Research in Management Science). Jun 1978. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Advocates of free markets for energy supplies argue that we do not need to have energy policies. A smoothly operating competitive price system is desirable, but there are three traditional arguments against full reliance on free pricing for some types of energy: some energy production and distribution is held to require the conditions of natural monopoly in its technology and scale requirements, thus forcing either public price regulation or nationalized productions and distribution; fuel production and burning are often a dirty business, producing pollutants as unwanted by-products or negative externalities and thus requiring that public interventions take place to offset the failure of the market to reflect adequately these social costs;and energy markets may fail to deal adequately with the future, and they may also give misleading signals about the important politics of energy, worldwide. The traditional reasons for energy regulation have come under sophisticated recent attack by liberal economists, who argue that greater economic efficiency would be achieved if some activities in the energy sequence were deregulated. Various domains of possible energy policies are identified in this discussion and 11 criteria of good public policy are defined. Examples of an energy policy consistent with each criterion are given. (MCW)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 44889, 45343

COAL

REFER ALSO TO CITATION(S) 44253, 44290, 44930, 45002

PETROLEUM

REFER ALSO TO CITATION(S) 44312, 44319, 44320, 44324

NATURAL GAS

REFER ALSO TO CITATION(S) 44343

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 44355

ELECTRIC POWER

44916 (BTHE—020338) **World electricity supplies: a survey of supply voltages throughout the world (second edition).** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). Aug 1978. 27p. Price to members $8.00.

These tables of the varied electricity supplies encountered throughout the world contain information obtained principally from the electricity supply organizations themselves. Users of these tables should note that in the more developed countries the voltage and frequency tolerances stated are statutory. However under certain circumstances all these tolerances can be exceeded and should be checked with the country concerned if wider variations could create a problem to the operation of the equipment. All domestic commercial and industrial supplies are included, excepting those above 22 kV. Both line voltage and phase voltage are given eg 380/220 (A) the affix (A) identifying the circuit diagram (at the rear of the tables) of the supply source connections.

44917 (CONF-790543—1) **Regional analysis models and interactive computer graphics at DOE laboratories: their use in power system planing.** Palmer, A.H.; Hillsman, E.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. NTIS MFA01.

From 11. power industry computer application conference; Cleveland, OH, USA (15 May 1979).

Portions of document are illegible.

A survey was made of regional analysis models and interactive computer graphic systems at three Department of Energy (DOE) laboratories. Specific practices were studied and a report was prepared describing applications, data bases, and interactive computer graphic systems. Many of these products have been applied to the study of electric utility systems and could be used for planning by the electric power industry. The view of power system planning held by researchers at DOE laboratories, the nature of the models which have been developed, the types of studies which have been performed, and the utilization of computer resources are described. Particular attention was given to the role of computer graphics in these studies. A comparison has been made with perspectives and practices of the electric power industry. DOE applications, data bases and computer graphic systems are emphasized. Applications include power plant siting; routing of transmission lines, air quality, water quality and land use modelling; and analysis of the esthetic, biomedical, fuel use and regional resource impact of different electric industry decisions. Many of these applications fall outside the historic conception of electric power system planning, but they deal with matters which utility companies are increasingly required to consider in their generation and transmission planning.

44918 (DOE/TIC—10083) **Electric supply report for fourth quarter of 1977 issued by Economic Regulatory Administration.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 15 May 1978. 25p. Dep. NTIS, PC A02/MF A01.

Bulk electric-power-supply outages, load-reduction measures, and other emergency situations covering the fourth quarter of 1977 are reported. Reports are made of power-supply status following any incident affecting bulk power-supply interruption and other problems related to the reliability of system and equipment. These reports are analyzed by ERA staff as a basis for recommending improved design or operating procedures to minimize future disturbances and outages. During the period from October 1 thru December 31, 1977, the Nation's electric utilities reported 18 incidents that were reportable per requirements of the Code of Federal Regulation (Article 141.58 C.F.R.). Of these 18 incidents, 10 were interruptions of bulk power supply involving loss of electric service to large numbers of customers, 4 incidents involved implementation of load-reduction measures in the form of voltages reduction or requests to the public to curtail load voluntarily, and 4 incidents involved hazards or equipment failure. Some of the major outages involving a large number of customers are listed.

44919 (DOE/TIC—10084) **Outages, load reductions, and other emergency situations bulk electric system. First quarter of 1978, January 1—March 31, 1978.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 1978. 47p. Dep. NTIS, PC A03/MF A01.

This report covers the bulk electric power supply outages, load reduction measures, and other emergency situations as delineated in Paragraph 141.58 of Title 18 Code of Federal Regulations. The report has three categories: bulk power-supply interruptions that result in loss of ultimate customer load, load reduction measures which do not necessarily result in disconnection of customers load, and events which constitute an unusual hazard to bulk electric power supply. All disturbances reported in first quarter of 1978 are briefly summarized for each classification in attached tables. Additional information for the major disturbances is given. Electric systems reported eleven bulk power supply interruptions in the January—March 1978 period.

44920 (DOE/TIC—10085) **Outages, load reductions, and other emergency situations bulk electric system. Second quarter of 1978, April 1—June 30, 1978.** (Department of Energy, Washington, DC

(USA). Economic Regulatory Administration). 1978. 21p. Dep. NTIS, PC A02/MF A01.

This report covers the bulk electric-power-supply outages, load-reduction measures, and other emergency situations reported to the DOE as required by paragraph 141.58 of Title 18 Code of Federal Regulations. The report has three categories: bulk power-supply interruptions that result in loss of ultimate customer load, load-reduction measures that do not necessarily result in disconnection of customers load, and events that constitute an unusual hazard to bulk electric-power supply. All disturbances reported in second quarter of 1978 are briefly summarized for each classification in attached tables. Additional information for the major disturbances is included. Electric utility systems reported nine bulk power-supply interruptions for the period.

44921 (DOE/TIC—10086) **Bulk electric energy supply system outages and load reductions. Fourth quarter of 1978, October 1—December 31, 1978.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 1978. 31p. Dep. NTIS, PC A03/MF A01.

This report summarizes information reported to the Department of Energy by electric utilities that experienced major electric-power-system outages or implemented measures to reduce their peak-load levels during the October to December period of 1978. The specific reporting requirements are delineated in paragraph 141.58 of Title 18, Code of Federal Regulations. Summary tables by category, along with a separate data compilation for each reported event, are included in this report. Outages reported as affecting more than 100 MW of customer load or one half of a system's peak load are listed. Summary information is provided regarding load-reduction measures implemented by electric utilities. The reporting criteria requires the reporting of all voluntary and mandatory load-reduction measures. Load-reduction measures include actions taken by electric utilities to reduce their customer load such that adequate generating resources are available. Other situations, including equipment failures that were considered at the time of occurrence a possible detriment to the reliability of the bulk electric energy supply system are summarized; such events do not normally result in immediate customer outages. Major distribution-system outages and problems are included in this category when reported. However, most electric-utility-distribution-system outages do not require reporting to the Department of Energy. Electric utility systems reported 19 major electric-energy-supply-system interruptions in October, November, and December of 1978. No reported outage affected over 100,000 customers.

44922 (DOE/TIC—10087) **Bulk electric energy supply system outages and load reductions. Third quarter of 1978, July 1—September 30, 1978.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 1978. 40p. Dep. NTIS, PC A03/MF A01.

This report summarizes information reported to DOE by electric utilities that experienced major electric-power-system outages or implemented measures to reduce their peak-load levels during the July to September period of 1978. The specific reporting requirements are delineated in paragraph 141.58 of Title 18, Code of Federal Regulations. Summary tables by category, along with a separate data compilation for each reported event, are included in this report. Outages reported as affecting more than 100 MW of customer load or one half of a system's peak load and summary information regarding load-reduction measures implemented by electric utilities are tabulated. The reporting criteria require reporting of all voluntary and mandatory load-reduction measures. Load-reduction measures include actions taken by electric utilities to reduce their customer load such that adequate generating resources are available. Other situations, including equipment failures considered at the time of occurrence a possible detriment to the reliability of the bulk electric energy supply system are summarized. Electric-utility systems reported 23 major electric energy-supply-system interruptions in July, August, and September of 1978. Three reported outages each affected over 250,000 customers.

44923 (EPRI-EA—1075) **Electric load forecasting: probing the issues with models. Final report.** (Stanford Univ., CA (USA)). Apr 1979. 62p. Dep. NTIS, PC A04/MF A01.

Changes in energy markets over the last decade have made capacity planning by electric utilities increasingly difficult, but also increasingly important to producers and users of energy. In particular, long-range forecasts of the use of electricity have received greater scrutiny, forecasting problems and methods have become more complex, and results have been subject to greater uncertainty and challenge than before. To shed light on these factors, the Electric Power Research Institute - in the Energy Modeling Forum - brought together a working group of people from utilities, research institutes, government agencies, universities, and consulting firms to identify the issues that could have significant impacts on future electricity consumption. To address some of these issues, the working group designed eight scenarios to assess the effects on electricity use of energy price changes, imposition of efficiency standards, movement to time-of-day pricing and technical change. The group exercised ten models currently used by utilities or government agencies to investigate these scenarios. The results indicate the relative strengths of the various methods employed by these models and the potential importance of the impact on electricity use of the issues investigated in the scenarios.

44924 (EPRI-EL—849(Vol.1)) **Determining load characteristics for transient performances. Volume 1. Management summary. Final report.** Chen, M.S. (Texas Univ., Arlington (USA). Energy Systems Research Center). May 1979. 85p. Dep. NTIS, PC A05/MF A01.

This study investigated the dynamic power response of loads (real and reactive) when subjected to excursions of voltage (50% to 120% nominal) and frequency (+- 5% nominal). Responses of components (air conditioners, motors, lighting, etc.) to changes in voltage and frequency were measured and component load models were developed from the resulting data. Typical industrial, commercial, and residential loads were physically simulated and instrumented. A prototype load-modeling procedure was developed. The results of this September 1976 to June 1978 study are reported in 3 volumes. This volume contains a management summary. An overview and summary of results are presented. Utility industry involvement during the period of research and applications of research results by various utility companies are also reported.

44925 (EPRI-EL—849(Vol.2)) **Determining load characteristics for transient performances. Volume 2. Testing and modeling of load components. Final report.** Chen, M.S. (Texas Univ., Arlington (USA). Energy Systems Research Center). May 1979. 117p. Dep. NTIS, PC A06/MF A01.

This study investigated the dynamic power response of loads (real and reactive) when subjected to excursions of voltage (50% to 120% nominal) and frequency (+- 5% nominal). Responses of components (air conditioners, motors, lighting, etc.) to changes in voltage and frequency were measured and component load models were developed from the resulting data. Typical industrial, commercial, and residential loads were physically simulated and instrumented. A prototype load-modeling procedure was developed. The period of performance was September 1976 to June 1978. The work is reported in three volumes. This volume contains information on the testing and modeling of load components. Basic load components are identified and their individual load characteristics defined. Mathematical models for each of the components are included. Comparisons of predicted and actual results on some composite loads are included. The test procedure, setup, and instrumentation are described. Test data are stored on magnetic tape. The format of stored data and the method of retrieving it are defined.

44926 (EPRI-EL—849(Vol.2)(App.A)) **Determining load characteristics for transient performances. Volume 2, appendix A. Final report.** Chen, M.S. (Texas Univ., Arlington (USA). Energy Systems Research Center). May 1979. 61p. Dep. NTIS, PC A04/MF A01.

This appendix contains documentation of the tests and results of the transient-performance tests. The tests performed at the Texas Power and Light Trinidad facility (Youth Camp) were recorded on magnetic tape and documented as to the configuration and the nature of each test. Of the tests performed, 56 data files were created, which represent the more-important results, and are included here. The facilities available permitted the simulation of residential, commercial, and light-industrial-type loads. Power was available from either a 300-kVA padmounted transformer or from a 200-kW diesel generator. Load-response data, in terms of real/reactive power, were recorded for various load compositions and individual loads as the source voltage and frequency were varied independently under prescribed conditions. Voltage and frequency were also recorded. Part (1) of this appendix contains the log of the 56 test configurations with documentation for each test on: one-line diagram of test configuration; nature and special conditions of test; and what, where, and how the recorded data are stored. Part (2) describes the formatting details concerning the 56 data files stored on high-speed magnetic computer tape obtained from the Trinidad tests. This documentation enables an individual to retrieve any particular set of test data that might be of interest to him for plotting and/or printing.If plotting is desired, a subroutine must be supplied to perform this function.

44927 (EPRI-EL—849(Vol.3)) **Determining load characteristics for transient performances. Volume 3. Procedure for modeling power system loads. Final report.** Chen, M.S. (Texas Univ., Arlington (USA). Energy Systems Research Center). May 1979. 101p. Dep. NTIS, PC A06/MF A01.

This study investigated the dynamic power response of loads (real and reactive) when subjected to excursions of voltage (50% to 120% nominal) and frequency (+- 5% nominal). Responses of components (air conditioners, motors, lighting, etc.) to changes in voltage and frequency were measured and component load models have been developed from the resulting data. Typical industrial,

commercial, and residential loads have been physically simulated and instrumented. A prototype load modeling procedure has been developed. The period of performance was September 1976 to June 1978. The work is reported in three volumes. This volume contains information on the procedure for modeling power system loads. The modeling philosophy and the prototype procedure for model building is described. Sensitivity analyses of the model building procedure are reported. A computer program was developed for use in load modeling. Its user's manual is included in a separate appendix.

44928 (EPRI-EL—849(Vol.3)(App.)) **Determining load characteristics for transient performances. Volume 3 appendix. Distribution System Aggregation Program (DSAP) user's guide. Final report.** Chen, M.S. (Texas Univ., Arlington (USA). Energy Systems Research Center). May 1979. 195p. Dep. NTIS, PC A09/MF A01.

This volume contains the descriptions, parameters, and operating information for using the DSAP computer code to obtain a steady-state or dynamic solution at the source (swing) bus of a balanced three-phase distribution system given the voltage of the source bus and the system frequency. More specifically, the types of distribution systems intended for representation in this program are composed of balanced three-phase feeder networks (radial or interconnected mesh) with a numer of linear, nonlinear, and dynamic loads connected at each bus.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 44262, 44471, 45005

44929 (EPRI-FFAS—1048) **Uncertainly methods in comparing power plants. Final report.** Balson, W.E.; Barrager, S.M. (Decision Focus, Inc., Palo Alto, CA (USA)). Apr 1979. 72p. Dep. NTIS, PC A04/MF A01.

A first step was taken in demonstrating how uncertainty can be explicitly quantified and included in estimates of future costs and performance of power-generating plants. The result is a procedure for obtaining a probability distribution for future costs that expresses the economic competitiveness of two technologies. The analytical tools of decision analysis were applied. Quantitative models and sensitivity analysis were used to identify the cost and performance variables that contribute most to overall cost uncertainty. Uncertainty in these variables was then expressed through subjective probability distributions, encoded during formal interviews with designated experts. Two case studies were performed to demonstrate this approach. The first was a comparison of two baseload technologies, a conventional coal-fired steam unit with flue-gas desulfurization and an integrated gasification—combined cycle unit. The second addressed the competition between storage batteries and oil-fired combustion turbines used for peaking duty. The technologies were compared at a single point in time and for a specific geographical region. In general the approach worked well and provided results in a usefeul form. No major technical problems were encountered. The sensitivity analysis and review processes were effective in organizing communication and focusing attention on critical issues.

44930 (ORNL/OEPA—9) **Potential institutional conflicts in the implementation of the Resource Conservation and Recovery Act and their impacts on the Department of Energy: a case study.** Carnes, S.; Tevepaugh, C.; Young, G.; DeVault, R.C. (Oak Ridge National Lab., TN (USA)). Feb 1979. Contract W-7405-ENG-26. 39p. Dep. NTIS, PC A03/MF A01.

Impacts of the Resource Conservation and Recovery Act (RCRA) of 1976 on two coal-fired generating plants and their operations were studied by reviewing relevant characteristics of the plants, their host communities, and their host states. The two plants, which are privately owned but whose power is committed to the DOE's Portsmouth Gaseous Diffusion Plant, are Clifty Creek Power Plant in Indiana and Kyger Creek Power Plant in Ohio. Assuming that ponding is an acceptable means of ash disposal, Clifty Creek should not be greatly impacted by RCRA unless local interests are concerned with the designation of the facility as a hazardous waste disposal site if ash is designated as hazardous by EPA. Kyger Creek may be impacted more due to marginally insufficient ponding capacity and an uncertain air pollution abatement future in Ohio (whether scrubbers will be required). The host communities are not likely to impose more stringent regulations and standards than EPA. Both of the host states are implementing RCRA but have insufficient resources to comply with mandated deadlines. It is quite likely that designation of hazardous waste facilities, generally, will invoke serious debate and possible opposition in host communities. Direct-combustion power plants, as a class, may be adversely affected by RCRA. Information flow to all coal users and waste generators must be assured to lessenthe costs of compliance with RCRA. Smaller facilities and entities are likely to be more adversely impacted by RCRA than large installations and industries.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 44968, 44969, 44970, 44985

44931 (DOE/TIC—10344) **Define data systems(s) for the Federal Energy Management Program. Technical report.** (Ultrasystems, Inc., McLean, VA (USA). Washington Operations). 26 Aug 1977. 103p. Dep. NTIS, PC A06/MF A01.

This report discusses the results of a field study of 76 representative Federal government organizational elements reporting data on energy consumption and savings to their management, who subsequently reported the data to the Federal Energy Administration, through the Federal Energy Management Program. Twenty-seven Federal Government agencies are required to record energy consumed, in all forms, so that data can be aggregated and reported. The data show energy consumption by period and percentages of change in consumption from the corresponding quarter of the base year.

44932 (PB—286955) **Growth and development of Tasmania's energy system: A statistical analysis of supply and demand, 1950-1975.** Hartley, M.J.; Jones, R.; Badcock, R.L. (Tasmania Univ., Hobart (Australia). Environmental Studies). 1978. 162p. NTIS PC A08/MF A01.

A partial listing of contents includes: Energy use in the residential-commercial sector; Energy use in the transport sector; Energy use in the manufacturing sector; Energy use in the mining sector.

UNCONVENTIONAL SOURCES AND POWER GENERATION

SOLAR

REFER ALSO TO CITATION(S) 44473, 44476, 44484, 44962

OTHER

REFER ALSO TO CITATION(S) 44468

44933 **No ill winds for New Mexico utility.** Reddoch, T.W. (Univ. of Tennessee, Knoxville); Klein, J.W. *IEEE Spectrum;* **16**: No. 3, 57-61(Mar 1979).

A wind turbine linked to the Clayton, N.M. utility system is providing 15 percent of the utility's off-peak power load. Sponsored a year ago as a Federal test project, the facility overcame several initial problems and is now undergoing technical and economic evaluation. The turbine was able to operate 80 percent of the time when winds were at acceptable levels (which was 57 percent of the time) and yielded an overall 20 percent efficiency. Performance data for the wind turbine and the integrated operation are summarized and future design changes based on the experiment are indicated. The isolated character of Clayton was found to minimize potential environmental impacts.

ENERGY CONVERSION

44934 (COO—4679-1) **Ferroelectric ceramics for dielectric power conversion. Annual report, December 1, 1977—February 28, 1979.** Payne, D.A. (Illinois Univ., Urbana (USA). Dept. of Ceramic Engineering). Feb 1979. Contract ER-78-S-02-4679. 59p. Dep. NTIS, PC A04/MF A01.

A new type of heat engine was disclosed in 1975 by J.E. Drummond, in which the working substance was not a gas or fluid, but a ferroelectric dielectric operating around its Curie point. High conversion efficiencies were claimed for Carnot cycles and multistage operations; and a figure of merit (M) was proposed to represent thermodynamic efficiency (n/sub c/) in terms of material parameters: M = βP/sub s/^{2}/4Cp/sub p/ = n/sub c/ where β, was the temperature dependence of dielectric stiffness (or inverse Curie constant). P/sub s/, spontaneous polarization, and C/sub p/, the specific heat at constant polarization. An investigation was undertaken to evaluate all ferroelectric materials as possible candidates for dielectric power conversion. Materials included: $LiTaO_3$, $LiNbO_3$, $BaTiO_3$, KTN, $PbTiO_3$, PZT, PLZT, $Ba_2NaNb_5O_{15}$, $Sr_3Ba_3Nb_{10}O_{30}$, KDP, $NaNO_2$, TGS Rochelle Salt, and $Pb_5Ge_3O_{11}$. Ceramic materials having the highest efficiencies were $PbTiO_3$, $LiNbO_3$, and $LiTaO_3$. The best organic materials were KDP and $NaNO_2$. Considerations outside the realm of thermodynamics limit the practical use of many organics and single crystals. The best commercial materials appear to be members of the PZST solid solution series, especially

those exhibiting field enforceable antiferroelectric-ferroelectric switching over wide temperature differentials. Data are given for the temperature dependence of dielectric and hysteretic polarization reversal. Summaries are presented for spontaneous polarization, β coefficients, specific heats, densities, electrocaloric and pyroelectric coefficients, Devonshire coefficients, Curie temperatures and switching times.

MHD GENERATORS

REFER ALSO TO CITATION(S) 44273

DESIGN AND DEVELOPMENT

44935 (ANL/MHD—79-7) **Analytical studies of NO/sub x/ decomposition in the radiant boiler of an open-cycle MHD power plant.** Sistino, A.J. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 88p. Dep. NTIS, PC A05/MF A01.

To determine the geometry of an open-cycle MHD radiant boiler and the fuel-air combustion stoichiometry that permit the decomposition of NO/sub x/ to an allowable EPA level [0.7 lb/10^6 Btu (0.3 g/J)] for various plant sizes, models of fluid flow, chemical kinetics, and heat transfer were constructed. Using various fuel-air stoichiometries and radiant boiler diameters, time histories of NO/sub x/ decomposition were calculated for inlet conditions of 2250 K and one atmosphere (Pa x 10^5) and the species equilibrium concentrations associated with these conditions. These clean-gas calculations yielded two significant diameters, (a) minimum diameter I, the smallest boiler diameter that meets the EPA standard, and (b) minimum diameter II, the diameter that is associated with the minimum residence time and meets the EPA standard. The boiler diameter is estimated by assuming a combustor stoichiometry, a boiler inlet velocity, power plant size (thermal input), and a coal heat value, and performing a heat balance. Given the diameter and the inlet NO/sub x/ concentration, the stoichiometry is determined by linear design curves of emissivity vs diameter, assuming the total emissivity (clear gas plus particle radiation) is shown. The stoichiometry is then used in the calculating boiler diameter and the procedure is repeated until consistency is obtained in the diameter, inlet NO/sub x/ concentration, emissivity, and stoichiometry. The residence time is calculated on the basis of the latter four variables, and the length of the boiler is given by inlet velocity times residence time. The assumptions used in the models and their limitations are examined.

44936 (FE—1760-32) **Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, January—March 1978.** Dicks, J.B. Jr.; Markant, H.P.; Crawford, L.W. (Tennessee Univ., Tullahoma (USA). Space Inst.). 15 Apr 1978. Contract EX-76-C-01-1760. 84p. Dep. NTIS, PC A05/MF A01.

A major step toward providing comprehensive on-line gas analysis was completed. Multiple inverters have been tested with a DC power supply. Testing with channel has begun. Construction of the Office/Laboratory Building, Coal Processing Area, etc., (Bid Package No. 1) is now 90 percent complete. UTSI has been working with Argonne National Laboratories to define the requirement specification and preliminary design for a superconducting magnet system for the coal-fired flow facility to be housed in the new structure. The joint materials program planned with Mississippi State University (MSU) is proceeding on schedule. Its objective is to select and test commercially acceptable metallic and ceramic materials for use in the radiant boiler.

44937 (FE—1811-20, pp 135-144) **MHD systems environmental impact study.** Brelsford, D.L. 1976.

In MHD power generation research, development, and engineering. Quarterly progress report, April—June 1976.

The objective of this project is to select a potentially suitable site for a large, western based, coal fired MHD steam plant facility. For purposes of this environmental impact analysis and siting exercise, the region of interest is limited to the state of Montana. The specific power plant to be conceptually sited is a completely integrated, direct coal fired, base load MHD steam power generating facility having a thermal input of 4000 MW. This work will result in the determination of a potentially suitable location and a conceptual site plan, along with recommendations for effluent control, waste disposal, and related environmental protection subsystems. Many of the inputs will be taken from the systems models developed in Task H1. The resultant determinations and recommendations will be based upon detailed considerations of appropriate environmental, economic, and social aspects related to the construction and operation of these subject MHD steam power plant facility.

44938 (FE—2524-8, pp 245-257) **ETF siting and environmental screening.** Chaffee, J.; Rognlie, D. 1978.

In MHD power generation: research, development and engineering. Quarterly progress report, January—March 1978.

Selection of environmentally and socially acceptable sites for magnetohydrodynamic (MHD) facilities requires the development of a scientific and justifiable screening methodology. Based on research into documented procedures and currently accepted practices, a methodology has been formulated for siting MHD plants. Although derived from MHD Engineering Test Facility (ETF) siting studies in Montana, the methodology is readily applicable to siting other energy facilities. Federal, state, and local facility siting laws and regulations have been identified and reviewed in a draft topical report. The documentation of these statutes will enable the Department of Energy (DOE) to plan future siting activities with greater efficiency.

44939 (FE—2613-6(Vol.1)) **MHD-ETF program final report. Volume 1. Executive summary.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 58p. Dep. NTIS, PC A04/MF A01.

A conceptual design study was performed to establish a reference design for a magnetohydrodynamic engineering test facility (MHD-ETF). Alternative conceptual designs were developed to the point where an evaluation and selection of a preferred concept could be made. The preferred conceptual design was then updated to provide an ETF reference design. Capital cost estimates and operating and maintenance cost estimates were then prepared. Critical advanced technology development requirements were identified. The ETF system configuration is a 250 MWt size, coal fired, MHD/Steam combined cycle plant. The steam turbine bottoming cycle operates with steam conditions of 3500 psia/1000 F at the exit of the steam generator. The steam is then throttled to 2400 psia/950 F to match the subcritical turbogenerator. The MHD topping cycle employs a fluidized bed gasifier/double vortex cyclone combustor subsystem which delivers plasma at a temperature of 4508 F when preheated air is supplied to the second stage combustor at 2983 F by a passively controlled, high performance, indirectly oil fired, ceramic regenerative heat exchanger subsystem. The MHD generator is a subsonic linear channel with 16% generator enthalpy extraction. Combined cycle efficiency of this pilot scale facility is 29.2% coal-to-pile-to-bus bar. This system is also capable of operation in a bottoming only mode.

44940 (FE—2613-6(Vol.2a)) **MHD-ETF Program final report. Volume IIA. Parts 1 and 2. Reference design description, January 4, 1977—March 4, 1978.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 239p. Dep. NTIS, PC A11/MF A01.

The ETF system configuration is a 250 MWt, coal-fired MHD/steam combined cycle plant. The system description and rationale is presented including size and flexibility, degree of slag rejection, NO/sub x/ prediction and its influence on the system, supercritical vs subcritical boiler, performance analysis, system operation, and reliability and maintainability. Also, a plant design description is given describing the plant buildings, boiler plant, steam turbine, accessory electrical equipment, power plant equipment, MHD cycle equipment, research equipment, and the station transmission plant. (WHK)

44941 (FE—2613-6(Vol.3)) **MHD-ETF program final report, January 4, 1977—March 4, 1978. Volume 3. Program implementation.** (General Electric Co., Philadelphia, PA (USA). Space Div.). Mar 1978. Contract EF-77-C-01-2613. 85p. Dep. NTIS, PC A05/MF A01.

This volume presents the estimated cost to construct, operate and maintain the ETF. In order for the cost estimates to be meaningful, they must be developed within the framework of an overall plan for the ETF. The assumed plans for the ETF are contained in Part 1. These plans cover the schedule for the design, procurement, construction, and shakedown of the ETF. In addition, a detailed sequence of subsystem and system testing, in the forms of an overall test and operations plan, is provided. The estimated cost to construct the ETF is contained in Part 2. The cost estimate is structured around a modified Federal Power Commission code of accounts for the construction of electric power generating plant. Part 3 contains the cost estimate for the operation and maintenance of the ETF. The estimate is based on six years of ETF operation and assumes a high maintenance and component modification/refurbishment activity in the early years of ETF operation. This is followed by a system testing phse in which successively longer test runs are accomplished, culminating with long term demonstration test runs. During these long term demonstration test runs the ETF is ooperated year round, with scheduled maintenance outages similar to these programmed into the operation of conventional power plants.

44942 (FE—2614-2(Pt.1)) **Engineering Test Facility conceptual design. Final report, Part 1.** (Avco-Everett Research Lab., Everett, MA (USA)). Jun 1978. Contract EF-77-C-01-2614. 562p. Dep. NTIS, PC A24/MF A01.

The conceptual design of a coal-fired combined-cycle MHD/steam power plant of pilot scale is presented. The overall ETF plant design description is given, and the ETF test program and project costs and schedules are presented. Design information is presented on the following subsystems and components: (1) MHD channel, (2) MHD channel calculations, (3) ETF channel performance, (4) mechanical design and construction, (5) channel instrumentation and controls, (6) ETF loading and consolidation circuitry channel, (7) MHD generator magnet, (8) coal combustor, (9) MHD generator inlet nozzle, (10) MHD generator diffuser and transition section, (11) high temperature air preheater system, and (12) LBTU gasifier (alternate clean fuel for high temperature air heater). (This design report is continued in Volume II). (WHK)

44943 (FE—2614-2(Pt.2)) **Engineering Test Facility conceptual design. Final report.** (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Jun 1978. Contract EF-77-C-01-2614. 487p. Dep. NTIS, PC A21/MF A01.

The conceptual design of the ETF pilot coal-fired combined-cycle MHD/steam power plant is continued from Volume I. Design information on the subsystems and components includes data on (1) the steam plant, (2) coal processing and handling, (3) seed recovery and management, (4) seed processing and handling, (5) inverter and electrical equipment, (6) MHD alternate exhaust gas bypass, and (7) the balance of plant. Also, design data are given on the instrumentation and controls; plant layouts, maintenance, and service; buildings and structures; and site and site development. Engineering drawings are included. A listing of the major pieces of plant equipment is appended. (WHK)

44944 (FE—3087-2, pp 182-185) **ETF siting and environmental screening.** Rognlie, D.; Cromer, J.; Chaffee, J. 1978.

In MHD power generation: research, development and engineering. Quarterly progress report, April—June 1978.

MHD Engineering Test Facility (ETF) siting studies have been conducted in Montana since March 1975. Based on these primary investigations and a current literature review, a methodology has been developed for siting MHD power plants. This siting plan presently is being revised, and information is being added to make the procedure more comprehensive.

44945 (TID—28718, pp 101-104) **Preliminary ETF environmental analysis and site study. Task M.** Dec 1976.

In MHD power generation: research, development, and engineering. Quarterly progress report, October 1—December 31, 1976.

An improved constraint weighting system was developed and applied through computer mapping techniques to select MHD-ETF candidate sites in each of six candidate regions in Montana. Maps of individual candidate regions in Montana were prepared showing the location of the identified candidate sites. Preliminary baseline environmental analysis of the candidate sites is being initiated.

44946 Development of a baseline reference design for an open cycle MHD power plant for commercial service. Jackson, W.D. (Energy Research and Development Administration, Washington, DC); Shanklin, R.V. III; Lawit, R.L.; Stoudt, R.A.; Klett, M.G.; Demetriades, S.T.; Cutting, J.C.; Maxwell, C.D.; Schnorr, R.F. pp III.3.1-III.3.9 of Engineering aspects of magnetohydrodynamics. Zauderer, B. (ed.). University, MS; Univ. of Mississippi (1976).

From 15. symposium on the engineering aspects of magnetohydrodynamics; Philadelphia, PA, USA (24 May 1976).

A detailed reference design for a coal-fired open cycle MHD/steam binary cycle power-plant is being developed under sponsorship of the United States Energy Research and Development Administration. The design effort is to be carried beyond the conceptual and preliminary stages so that hardware procurement specification actually could be written. The conceptual basis for the design, the envelope of economic and engineering constraints within which plant optimization has been carried out, and selected critical design problems are described. It is shown that for certain coals, fuel preprocessing promises significant benefits. The impact of coal drying and its influence on bottoming plant design is examined in detail. Also discussed are plant start-up, availability, NO/sub x/ control problems, and the approach to instrumentation and control to be used.

PERFORMANCE AND TESTING

44947 (ANL/MHD—79-3) **Parametric study of the performance of a CDIF 1-B coal-fired MHD generator.** Ahluwalia, R.K.; Geyer, H.K.; Doss, E.D. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 55p. Dep. NTIS, PC A04/MF A01.

A comprehensive study is conducted into the analysis of a coal-fired CDIF 1-B channel performance to simulate the characteristics of the reference ETF channel. The performance criteria are established by careful review of the role played by the gas dynamic and electrical variables in determining channel behavior. On the basis of this review, a constant-velocity subsonic channel operating at nominal combustor pressure of 5.4 atm (0.54 MPa) is selected. The channel loading is selected to obtain a maximum Hall field of 2.4 kV/m and maximum transverse current density of 1.1 A/cm^2. As suggested, the channel requires a special pressure dissipation system at the exit. An arrangement consisting of a constant area transition section followed by a subsonic diffuser is suitable for this purpose; its presence, however, complicates the off-design analysis of the channel. Three off-design modes are identified, which depend upon whether the flow is subsonic in the channel but supersonic in the downstream components, subsonic everywhere, or supersonic in the channel and subsonic/supersonic in the downstream components. The off-design conditions may stem from altering mass flow rate, combustor pressure, magnetic field, loading, or a combination of them. These off-design modes are successfully analyzed with the aid of an optimizer capable of handling boundary value problems. The extent to which this CDIF 1-B channel simulates the reference ETF characteristics is discussed. It is concluded that the CDIF 1-B channel performance in this study will fulfill its objective of providing experimental experience with the anticipated characteristics of the ETF channel.

44948 (DOE/NASA/2674—79/4) **MHD performance calculations with oxygen enrichment.** Pian, C.C.P.; Staiger, P.J.; Seikel, G.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EF-77-A-01-2674. 31p. (CONF-790640—1). Dep. NTIS, PC A03/MF A01.

From 18. symposium on engineering aspects of magnetohydrodynamics; Butte, MT, USA (18 Jun 1979).

The effect of oxygen enrichment of the MHD combustion air on the channel and plant performance has been studied for the ECAS-2 type plants. The MHD channel power output is optimized as a function of various generator parameters and physical constraints. The salient differences between the maximum power and maximum net power generators are described. Directly and indirectly-preheated plant performances with O_2 enrichment are calculated. Results show that there is an optimum level of oxygen enrichment for each given plant type, preheat temperature, and assumed oxygen production cost. The optimum degree of enrichment rises with decreasing preheat temperature. Using current O_2 production costs, oxygen enrichment was found to be beneficial for directly-preheated plants if the preheat temperature is less than 1800 to 2200F. Oxygen enrichment was found to be advantageous in separately-fired plants for preheat temperatures less than 2500 to 3000F. However, this performance gained due to enrichment in the separately-fired plants must be weighted against the increased capital cost of having both a separately-fired preheater system and an oxygen plant. This report emphasizes the performance aspects of MHD plants using oxygen enrichment. Results of ongoing air-separation plant studies (managed by NASA and funded by DOE) will be required to define the cost of electricity.

MATERIALS, COMPONENTS, AND AUXILIARIES

44949 (ANL/MHD—78-6) **Program plan for development of heat and seed recovery components for a coal-fired, open-cycle MHD power plant.** Johnson, T.R. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 110p. Dep. NTIS, PC A06/MF A01.

A comprehensive plan for the development of the heat recovery and seed recovery (HRSR) components for an integrated open-cycle, coal-burning MHD power plant is outlined. The program should assure that the necessary engineering and design information will be available for the development and procurement of components for large-scale (150 to 300-MW) integrated MHD power plant. The HRSR systems in this plant should perform with a degree of reliability sufficient to demonstrate the feasibility of commercial power plant operations. The general operational requirements for the downstream gas system are presented, and several large-scale MHD plant concepts are briefly described. From these concepts, composite HRSR reference flowsheets were developed for the purpose of focusing the development work. The reference designs and concepts are used for illustrative and discussion purposes only; they should not be interpreted as restricting the scope of the HRSR development program to a single concept. The problem areas and issues which must be addressed for the various component and subsystems are discussed. Following the discussion of the technology issues, an assessment of the relevant state of the art for each of the components is presented, and the deficiencies in the technology are identified. A description of the research and development program plan is then presented.

44950 (ANL/MHD—78-10) **MHD Balance-of-Plant Technology Project. Third quarterly report, July—September 1978.** Petrick, M.; Tempelmeyer, K.E.; Johnson, T.R. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 89p. Dep. NTIS, PC A05/MF A01.

The MHD Balance-of-Plant Project at Argonne National Laboratory is obtaining information pertinent to the design and operation of the heat and seed recovery systems downstream of the channel-diffuser and to the seed regeneration processes. The project goal is to supply the engineering data needed to design components for MHD prototype and demonstration facilities. The work is being done in cooperation with other DOE contractors working in this general area. The project activities currently include: (1) preparation of a program plan for heat and seed recovery systems, (2) analytical modeling of the heat transfer, NO/sub x/ behavior, and seed-slag separation processes in the radiant boiler, (3) modeling of the formation growth, and behavior of slag and seed particles in the combustion gas stream, (4) studies of the thermochemistry of seed-slag systems, (5) investigations of ceramic and metallic materials for use in the downstream gas systems, (6) small-scale engineering studies of seed-slag deposition, (7) design and construction of a 2-MW experimental facility for investigations pertaining to the downstream gas system, and (8) evaluations of seed regeneration processes.

44951 (ANL/MHD—79-5) **MHD heat and seed recovery technology project. Fourth quarterly report, October—December 1978.** Petrick, M.; Tempelmeyer, K.E.; Johnson, T.R. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 48p. Dep. NTIS, PC A03/MF A01.

The MHD Heat and Seed Recovery Project at Argonne National Laboratory is obtaining information pertinent to the design and operation of the heat and seed recovery systems downstream of the channel-diffuser and to the seed regeneration processes. The project goal is to supply the engineering data required in the design of components for prototype and demonstration MHD facilities. The present project activities include: (1) analytical modeling of the heat transfer, NO/sub x/ behavior, and seed-slag separation processes in the radiant boiler, (2) studies of the thermochemistry of seed-slag systems, (3) investigations of ceramic and metallic materials for service in the downstream gas systems, (4) small-scale engineering studies of seed-slag deposition, (5) construction of a 2-MW experimental facility and the test apparatus for conducting investigations pertaining to the downstream gas system, and (6) evaluation of seed regeneration processes. Progress is reported.

44952 (TID—28718, pp 86-92) **MHD instrumentation and data acquisition. Task H1.** Dec 1976.

In MHD power generation: research, development, and engineering. Quarterly progress report, October 1—December 31, 1976.

A conceptual design of an air preheater system suitable for a 250 MWt Engineering Test Facility (ETF) plant was completed. A computer dynamic simulation model of the high temperature air preheater (phased array regenerative heat exchangers) was used to study the characteristics of the system with and without a series heat capacitor between the phased array and the combustor. The phased array of heat exchangers operating on a steady-state basis produced on air ripple temperature of +- 13.2 K. Doubling the number of heat exchangers resulted in the reduction of the ripple temperature by 50 percent. A configuration consisting of 4 reheat, 4 blowdown, and a series heat capacitor produced a temperature ripple of only +-.35 K. This system would cost approximately 20 percent less, based on material requirements, than a pure 8 blowdown, 8 reheat system which produced a temperature ripple of +- 7.35 K.

44953 Computing the magnetic field of superconducting coils of various geometries for mhd dipol magnets. Atanasiu, G.; Constantin, E.; Popa, I.; Radu, D. (Polytech Inst Tr. Vuia, Timisoara, Rom). *Rev. Roum. Sci. Tech., Ser. Electrotech. Energ.;* **23**: No. 2, 209-215(1978). (In German and English).

Several methods are reported for calculating the magnetic field of MHD generator coils. For a given MHD channel with variable orthogonal cross-section three dipol magnetic versions are calculated.

DUCT ENGINEERING AND FLUID DYNAMICS

44954 Coal slag effects in MHD generators. Koester, J.K.; Rodgers, M.E.; Nelson, R.M.; Eustis, R.H. (Stanford Univ., CA). pp 627-650 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Experiments have been conducted on the formation and properties of slag coatings resulting from the direct firing of coal under simulated MHD generator conditions. The hydrodynamic behavior of the thin slag coatings were studied for various coals and types of channel wall. Stable, continuous coatings were achieved over suitable substrates. Slag layer characteristics, such as thickness, surface temperature, and development time were measured and compared with theory. The response of slag layers to applied transverse and axial discharges under MHD generator duct conditions was investigated for various metal electrodes and two different coals. Axial slag breakdown and both diffuse and arc mode transverse discharges were observed with cinephotography. The critical current density for diffuse mode operation was an order of magnitude larger for mild steel electrodes than for stainless steel or nickel electrodes. Measured values of slag layer resistance increased rapidly with decreasing electrode temperature. A large contact resistance was measured for the slag layer over the nickel electrode. The excellent slag contact with the steel electrode was traced to chemical interaction of the slag with an iron oxide film on the electrode surface. The large variations in difuse mode performance for different electrode materials is shown to correlate well with a function of slag layer resistance. The erosion rates of low carbon steel electrodes operating diffusely under slag were measured. Steel cathodes were not attacked; however, steel anodes were severely eroded which suggests electrochemical corrosion due to ionically conducting species in the slag layer. Large differences in slag microstructure over the cathode versus the anode were observed.

44955 Corrosion and deposits in MHD generator systems. Dicks, J.B.; Crawford, L.W.; Petersen, C.K.; Beaton, M.S. (Univ. of Tennessee Space Inst., Tullahoma). pp 651-663 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Experiences in deposition of and corrosion—erosion by ash constituents and ash-additive mixtures in the University of Tennessee Space Institute MHD Laboratory are described. Particular components which are discussed include the combustor, the MHD generator and gas ducts, high temperature heat transfer surface, and low temperature heat transfer surface. Effects of the deposits on metallic and ceramic materials are considered.

44956 Controlled utilization of coal slag in the MHD topping cycle. Stickler, D.B.; DeSaro, R. (Avco Everett Research Lab., Inc., MA). pp 665-688 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

Slag coating development for structural protection from gas dynamic erosion, and from current concentrations in the MHD channel, is described. Experimental and analytical study of the behavior of coal ash on the wall structures of MHD systems has resulted in an understanding of controlling transport processes. Experimental measurements under both subsonic and supersonic conditions indicate that on a wettable wall structure, operating at temperatures well below T/sub 250/, slag develops by deposition from the gas flow at a predictable rate. A layer equilibrates with a viscosity-temperature distribution defined by balancing of local mass flow in the layer with skin friction and pressure gradient forces driving it. Typically, at 0.3 wt% mineral matter in a mach 1.4 flow, equilibration time is about forty minutes. This is somewhat greater than predicted by simple theory, due to the existence of a finite rate of re-entrainment prior to equilibration. The steady state layer is on the order of one mm thick, with surface temperature about 1800°K. Effects of ash composition, combustion stoichiometry, flow field, and wall structure are discussed, together with corresponding analyses.

THERMIONIC CONVERTERS

44957 (DOE-tr—1) **Thermionic converters and low-temperature plasma.** Baksht, F.G.; Dyuzhev, G.A.; Martsinovskiy, A.M.; Moyzhes, B.Ya.; Pikus, G.Ye.; Sonin, E.B.; Yur'yev, V.G. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1978. Translation of Termoemissionnye preobrazovateli i nizkotemperaturnaia plazma; Izdatel'stvo Nauka, Moscow, 1973. 490p. Dep. NTIS, PC A21/MF A01.

The fundamental physical processes in plasma diodes (the phenomena of plasmas and electrode surfaces), the methods for investigating the low-temperature plasma of thermionic converters, and the investigation of physical processes in thermionic converter (TIC) plasmas and pre-electrode sheaths that occur in the various operating modes are outlined. The sections of the book include (1) thermionic converters and low-temperature plasma, (2) emission and adsorption processes (TIC electrodes), (3) elementary processes in a plasma, (4) kinetic phenomena in the plasma, (5) ionization and recombination in a low-temperature plasma, (6) pre-electrode phenomena in a TIC plasma, (7) experimental methods for investigating low-temperature plasmas, (8) the diffusion mode of thermionic converters, (9) the low-voltage arc in a TIC, (10) the direct-flight (Knudsen) mode of TIC operation, and (11) some engineering problems of TIC's. (WHK)

PERFORMANCE AND TESTING

44958 Optimization of the parameters of a Knudsen thermionic converter with Cs-Ba filling. Babanin, V.I.; Kuznetsov, V.I.; Mustafaev, A.S.; Sitnov, V.I.; Ehnder, A.Ya. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). *Zh. Tekh. Fiz.;* **48**: No. 4, 754-766(Apr 1978). (In Russian).

The problem of optimizing the thermionic converter in a Knudsen regime is discussed. The potential distributions in the thermionic converters with surface ionization are investigated. Special attention is paid to the transfer region from the overcompencated to the under compensated regime. The optimization of the saturation current and comparison of the thermionic converter maximum current with the chaotic current in an equilibrium isothermal cavity are carried out. In optimizing capacity a generalized volt-ampere characteristic notion is introduced. This characteristic is used for the anode work function determination and output power calculation. The experimental data agree well with the calculation results and show high efficiency of the thermionic converter with Cs - Ba filling.

FUEL CELLS

REFER ALSO TO CITATION(S) 44962

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 44217

44959 (DOE/NASA/1002—78/2) **Redox flow cell development and demonstration project, calendar year 1977.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jan 1979. Contract EC-76-A-31-1002. 53p. (NASA-TM—79067). Dep. NTIS, PC A04/MF A01.

Research and development on the redox flow cell conducted by the NASA Lewis Research Center for the US Department of Energy from January 1, 1977, to December 31, 1977, are described. The major focus of the effort during 1977 was the key technology issues that directly influence the fundamental feasibility of the overall redox concept. These issues were the development of a suitable ion exchange membrane for the system, the screening and study of candidate redox couples to achieve optimum cell performance, and the carrying out of systems analysis and modeling to develop system performance goals and cost estimates.

44960 (N—78-29567) **Solid polymer electrolyte (SPE) fuel cell technology program. Final report.** (General Electric Co., Wilmington, MA (USA). Aircraft Equipment Div.). 15 Mar 1978. Contract NAS9-15286. 88p. NTIS PC A05/MF A01.

Many previously demonstrated improved fuel cell features were consolidated to (1) obtain a better understanding of the observed characteristics of the operating laboratory-sized cells; (2) evaluate appropriate improved fuel cell features in 0.7 sq ft cell hardware; and (3) study the resultant fuel cell capability and determine its impact on various potential fuel cell space missions. The observed performance characteristics of the fuel cell at high temperatures and high current densities were matched with a theoretical model based on the change in Gibbs free energy voltage with respect to temperature and internal resistance change with current density. Excellent agreement between the observed and model performance was obtained. The observed performance decay with operational time on cells with very low noble metal loadings (0.05 mg/sq cm) were shown to be related to loss in surface area. Cells with the baseline amount of noble catalyst electrode loading demonstrated over 40,000 hours of stable performance.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 44961

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 44959

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

44961 Anode electrochemistry in selected molten carbonate melts. Sammells, A.F.; Ang, P.P.G. Chicago, IL; Institute of Gas Technology (1978). 17p. (CONF-7810130—1).

From The molten carbonate fuel cell workshop; Oak Ridge, TN, USA (31 Oct 1978).

The electrochemistry of fuel oxidation in molten carbonates using nickel and cobalt anodes has been evaluated with steady-state, linear sweep, and transient potentiostatic techniques. Activation kinetics for fuel oxidation have been measured in three molten carbonate mixtures, with compositions of 62 mole percent Li_2CO_3-38 mole percent K_2CO_3, 52 mole percent Li_2CO_3-48 mole percent Na_2CO_3, and 43.5 mole percent Li_2CO_3—31.5 mole percent Na_2CO_3—25 mole percent K_2CO_3. The highest exchange current densities were found for the ternary (LiNaK) melt using a nickel anode, where $i_0 = 78$ mA/cm² with intermediate-Btu fuel and 22 mA/cm² with low-Btu fuel at 650°C. The exchange current density was found to have a reaction order of around 0.25 for hydrogen, carbon dioxide, and water. Electrochemical performance on the two anode materials in the three melts is discussed, and a tentative reaction mechanism for the oxidation reaction is suggested.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 44290, 44911

44962 (BNL—50998) **Abstracts of reports published in Energy Technology Programs of the Department of Energy and Environment. Progress report, January—December 1978.** (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 130p. Dep. NTIS, PC A07/MF A01.

Abstracts of reports published in Energy Technology Programs of the BNL Department of Energy and Environment during 1978 are presented. The two general areas of technology covered are as follows: conservation and solar technology (oil- and gas-fired space-conditioning systems, energy conservation in buildings, solar-assisted heat pumps and cooling systems, conservation program management) and energy technologies (energy storage by chemical means, energy conversion in fuel cells and combustion devices, fossil energy conversion, combustion, and environmental control, program management).

BUILDINGS

REFER ALSO TO CITATION(S) 44868, 44906, 44907

44963 Insulated construction block. Toone, C.A. US Patent 4,148,166. 10 Apr 1979. Filed date 3 Mar 1978. 14p.

The disclosed insulated construction block incorporates improved insulating features which minimize thermal conduction through the block itself and through mortar joints between adjacent blocks in a masonry wall. The block includes a recessed end face designed to receive an insulation insert in a vertical mortar joint between adjacent blocks and to maximize the amount of insulation in the mortar joint. The recess overlaps interior insulating spaces within the construction block to minimize heat loss through the end walls of the block. The insulating inserts received in the mortar joint and interior insulating spaces are greater in height than the block to project into the horizontal mortar joints above or below the block.

44964 (DOE/TIC—10305) **Survey existing microprocessor systems, components, and software (EMS).** (JRB Associates, Inc., McLean, VA (USA)). 19 Jan 1977. 175p. Dep. NTIS, PC A08/MF A01.

The energy management systems presently on the market are made by more than 13 manufacturers. This report identifies manufacturers, types of systems, functional capacities and components, cost (based on manufacturers' list prices), configuration or architecture of the systems, and limitations in controlling a building's energy system. Although some estimated installation and other associated costs of the EMSs are included, the report is not a manual for estimating installed costs of EMSs in a particular situation.

44965 (LBL—8925) **Thermal performance of buildings and building envelope systems: an annotated bibliography.** Carroll, W.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 41p. Dep. NTIS, PC A03/MF A01.

A bibliography of published papers describing models, measurement techniques, apparatus, and data for the thermal performance of whole buildings and building envelope systems has been collected (aggregate energy consumption of whole buildings, performance of HVAC equipment, and solar technologies are not included). Summary descriptions of the content of each citation are provided. Measurements on whole buildings or on systems other than walls are sparse. However, new and recently completed measurement facilities are increasing these capabilities. Measurements under dynamic conditions are difficult to accomplish and few reliable data exist. Some analogs have been explored experimentally and analytically. Citations on analytical models are selective and concen-

trate on methodology that forms the basis of computer programs for whole-building energy analysis. Interesting future directions include new approaches to dynamic measurements, both in the laboratory and in the field, for envelope systems and for whole buildings.

44966 (N—78-33510) **Aerial thermography for energy conservation.** Jack, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1978. 22p. NTIS PC A02/MF A01.

Thermal infrared scanning from an aircraft is a convenient and commercially available means for determining relative rates of energy loss from building roofs. The need to conserve energy as fuel costs increase makes the mass survey capability of aerial thermography an attractive adjunct to community energy awareness programs. Background information on principles of aerial thermography is presented. Thermal infrared scanning systems, flight and environmental requirements for data acquisition, preparation of thermographs for display, major users and suppliers of thermography, and suggested specifications for obtaining aerial scanning services were reviewed.

44967 (PB—284497) **Effects of moisture in built-up roofing. A state-of-the-art literature survey. Final report.** Busching, H.W.; Mathey, R.G.; Rossiter, W.J. Jr; Cullen, W.C. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jul 1978. 81p. NTIS PC A05/MF A01.

A literature review of the effects of moisture on built-up roofing was made. Quantitative data were summarized for some properties of membrane roofing including: permeability, absorption, thermal expansion, thermal resistance, tensile strength, modulus, and fungus attack resistance. Example calculations of possible temperature and moisture gradients for two typical roof sections were presented. Nondestructive evaluative methods to locate moisture in roofing systems were summarized and include gravimetric, nuclear, capacitance, infrared imagery, electrical resistance, and microwave methods. A review of techniques to dissipate moisture in roofing is presented.

44968 (TID—28820) **Base data for the development of energy performance standards for new buildings. Phase one, task report: building classification, January 12, 1978.** (AIA Research Corp., Washington, DC (USA)). Oct 1978. Contract EX-76-A-29-1020. 129p. Dep. NTIS, PC A07/MF A01.

This research develops a system for the classification of building types suitable for the collection of designed energy-performance data and the implementation of national energy performance standards for new construction. A General Classification Scheme for building types was derived primarily from the occupancy descriptions in standard building codes, to assure compatibility with classifications currently accepted in the construction review process. A Classification System for Data Collection was condensed from the General Classification Scheme. This system includes four levels of description: building category, building type, plan type, and space use.

44969 (TID—28822) **Base data for the development of energy performance standards for new buildings. Phase one, task report: sample design, January 30, 1978.** (AIA Research Corp., Washington, DC (USA)). Oct 1978. Contract EX-76-A-29-1020. 108p. Dep. NTIS, PC A06/MF A01.

This report provides documentation of the sample design used to conduct the survey for Phase I of the HUD Baseline Building Study. It covers: (1) the various considerations that were involved in the choice of the details of the sample design used; (2) the details of the sample selection and control; (3) the details of computation procedures for estimates and confidence intervals of the estimates; and (4) an evaluation of the sampling variability actually achieved.

44970 (TID—28823) **Base data for the development of energy performance standards for new buildings. Phase one, task report: data collection, January 12, 1978.** (AIA Research Corp., Washington, DC (USA)). Oct 1978. Contract EX-76-A-29-1020. 49p. Dep. NTIS, PC A03/MF A01.

This task collected data for estimating the designed energy performance of a random selection of recent residential and nonresidential buildings, as part of the first phase in the development of energy-performance standards for new construction. A building survey was conducted with extensive field support to monitor the completion of survey forms and ensure sample control. Buildings and their designers were identified through Dodge Construction Reports. Each building selected for the sample was assigned to a regional team of field representatives, who monitored and assisted in the completion of the survey forms. Weather data were obtained from the National Oceanographic and Atmospheric Administration for each of the building locations for use in estimating the designed energy performance of each sample building.

44971 **Water heating system and combined storage tank and heat exchanger unit therefor.** Gehring, K.C. (to DEC International, Inc.). US Patent 4,148,355. 10 Apr 1979. Filed date 21 Mar 1977. 10p.

The invention discloses a combined storage tank and heat exchanger unit for heating water including a watertight tank having a water inlet in the lower portion thereof and a pair of water outlets in the upper portion thereof. The wall of the tank is in the form of a double wall jacket having a hot refrigerant inlet at the top portion thereof and a hot refrigerant outlet at the bottom portion thereof. A cylindrical heat barrier is mounted inside the tank and spaced a short distance from the inside surface of the jacket wall to thermally isolate a relatively small amount of water in the tank in direct contact with the inner surface of the jacket. A heat barrier disc is mounted in the tank and extends horizontally across the interior thereof to thermally isolate the water in the top portion of the tank from the water in the bottom portion thereof. The water outlets communicate with the interior of the tank on opposite sides of the partition to provide heated water at two distinctly different temperatures. An air passageway is provided between the outer surface of the jacket and the inner surface of the outer shell through which air is circulated to heat the room in which the unit is located.

44972 **Method and equipment for heat recovery from waste water in buildings.** Iwan, K. (to BERO - Energie Beratung und Organisation fuer Waermerueckgewinnung G.m.b.H. und Co. K.G., Duesseldorf (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,715,045/A/. 12 Oct 1978. 12p. (In German).

This is a process for the recovery of household waste heat. The warm waste water is stored in containers. Heat is removed from this water by means of a heat exchanger and is fed to a heat pump. The heat pump is operated by an internal combustion engine which is natural-gas-fired. The hot water can be fed directly into a water tank and heated to higher temperatures if necessary.

44973 **Heat pump.** Eiermann, D.; Kraic, O. (to Borsig G.m.b.H., Berlin (Germany, F.R.); Wankel G.m.b.H., Berlin (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,635,971/A/. 23 Feb 1978. 10p. (In German).

A heat pump is claimed where part of the power necessary for compression of the circulating medium is used in the expansion aggregate. The expansion aggregate is a highly compact compressor expansion aggregate with very high rotational speed that runs dry.

44974 **Heat pump of stirling engine type.** Tausend, E. (to Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,620,214/A/. 24 Nov 1977. 8p. (In German).

By this addition to patent 2519869.0, the hot gas engine working on the Stirling cycle described therein is modified so that it can work as a heat pump at high efficiency. In a two cycle process, the working gas is heated directly in the cooling regenerator by the heat source (air or water) with minimum temperature and flow losses. As the volume of the cooling regenerator seapration from the main working circuit does not affect the compression ratio, this can be of any size, i.e. it can be designed for maximum thermal efficiency. The parts of the cooling circuit, as they are only subjected to system pressure, can be made of plastic material. Plastic or aluminium can also be used in the heater-heat exchanger.

44975 **Accumulator water heating system for district heating plants.** Hoefeld, G.; Wagner, L. (to Buderus A.G., Wetzlar (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,550,581/A/. 12 May 1977. 8p. (In German).

The water heater consists of a container with a service water inlet in its lower and a service water outlet in its upper part and a heat-exchanging surface inside the container which is connected with the forward and recirculation line of the district heating network. Another heat exchanger is connected with the lower part of the container; this heat exchanger is designed as a double jacket through which the recirculated water flows. This way, the energy contained in the district heating water can be better utilized. The internal and external heat exchanger may also be connected in series by means of a connecting nozzle.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 44607

44976 (DOE/TIC—10628) **Household energy costs and consumption, 1973—1975.** Kacser, P.H.; Siler, A. (Federal Energy Administration, Washington, DC (USA)). Jan 1977. 8p. Dep. NTIS, PC A02/MF A01.

Data obtained from two nationwide household surveys conducted in May 1973 and in May 1975 on annual energy use and expenditures by U.S. income groups were compiled and tabulated. The tables show the cost and amount of electric power, natural gas, and fuel oil consumed by lower, middle, and upper income families. Electric power consumption decreased very slightly for the middle

income groups and increased for both the lower and upper income groups. The 69% of U.S. households which use natural gas decreased the overall gas consumption by 4%. The 20% of the population using fuel oil had the highest expenditure for any energy product used in the home. (LCL)

44977 (DOE/TIC—10630) **Preparation and production of a home builders' guide: building and selling energy-efficient homes.** Keast, D.N.; Mahoney, J.M.; McMahon, N.M.; Troy, M.H.; Wood, E.W. (Bolt, Beranek, and Newman, Inc., Cambridge, MA (USA)). Jun 1977. 108p. Dep. NTIS, PC A06/MF A01.

Procedures used in the preparation of a manual on the construction of energy-saving one- and two-family houses are described. Prior to writing the manual, builders were interviewed and a bibliographic search was conducted to obtain information on the design, construction and marketing of energy conserving homes. The packaging and distribution of the manual was planned. When written FEA will publish the manual. (LCL)

44978 (LBL—8949) **Electric co-heating: a method for evaluating seasonal heating efficiencies and heat loss rates in dwellings.** Sonderegger, R.C.; Modera, M.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 14p. (EEB-ENV—79-6; CONF-790523—4). Dep. NTIS, PC A02/MF A01.

From 2. international CIB symposium on energy conservation in the built environment; Copenhagen, Denmark (27 May 1979).

An experimental technique called electric co-heating is presented. Portable electric heaters distributed throughout the dwelling to be tested are operated overnight at the same time as the regular heating system. Cross-correlation with outside temperature data collected several times per hour allows the separate determination of heating efficiency, fireplace performance and overall building heat loss coefficient. Electric co-heating is applied to measure the net efficiency of a forced-air gas furnace and a fireplace in a house located in the San Francisco Bay Area. Preliminary tests conducted in mild weather indicate a net efficiency of 53% for the heating system and less than 5% for the fireplace.

44979 (LBL—9099) **Elderly housing characteristics: planning and service areas, State of California. 1970 census of housing.** Burkhart, B.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 383p. Dep. NTIS, PC A17/MF A01.

Elderly Housing Characteristics for Planning and Service Areas in California contains a collection of statistics selected and organized to describe occupied residential housing conditions of older population who live independently in the state. Seventeen major housing characteristics are tabulated: number of rooms and persons, plumbing facilities, year structure built and head moved into unit, unit income and value, number of bedrooms and automobiles, monthly gross rent, second home ownership, units in structure by owner and renter, value/income ratio, gross rent as percentage of income, unit value by income, income and gross rent as percentage of income. In all tables for this report, the state and PSA totals are disaggregated to show household type, tenure, sex, and racial characteristics. PSA's consist of single counties or groups of counties designated by the California State Office on Aging. (MCW)

44980 (PB—284308) **Complications in implementing home weatherization programs for the poor. Report to the Congress.** (General Accounting Office, Washington, DC (USA). Health Resources Div.). 2 Aug 1978. 65p. NTIS PC A04/MF A01.

The report discusses complications encountered by the Community Services Administration and the Department of Energy in operating parallel home weatherization programs for low-income families. These programs were reviewed to determine what measures were being taken to coordinate Federal efforts and what progress was being made to achieve program objectives.

44981 (PB—287676) **FTC Advertising Substantiation Program. Household products manufacturers. Documentation of the Tappan Company.** (Federal Trade Commission, Washington, DC (USA). Bureau of Consumer Protection). 1978. 717p. NTIS PC A99/MF A01.

The report contains documentation in support of claims that the Tappan Convectionaire Gas Range cooks every type of food in half the time, using 50% less gas than that required by conventional ovens which do not have the forced convection cooking feature. (Portions of this document are not fully legible) (Color illustrations reproduced in black and white)

44982 (PB—287677) **FTC Advertising Substantiation Program. Household products manufacturers. documentation of the Carrier Corporation.** (Federal Trade Commission, Washington, DC (USA). Bureau of Consumer Protection). 1978. 709p. NTIS PC A99/MF A01.

The report contains documentation in support of claims that the Carrier Year-Round-One heat pump air conditioner cuts electric heating costs by 60% in all climatic regions of the country, and operates less expensively than oil-fueled heating systems, in terms of energy costs. (Color illustrations reproduced in black and white) (Portions of this document are not fully legible)

44983 (PB—287703) **FTC Advertising Substantiation Program. Household products manufacturers. Documentation of N. W. Ayer ABH International.** (Federal Trade Commission, Washington, DC (USA). Bureau of Consumer Protection). 1978. 300p. NTIS PC A13/MF A01.

The report contains documentation in support of claims that the Carrier Year-Round-One heat pump air conditioner cuts electric heating costs by 60% in all climatic regions of the country, and operates less expensively than oil-fueled heating systems, in terms of energy costs. (Portions of this document are not fully legible) (Color illustrations reproduced in black and white)

44984 (PB—287752) **Cybernetic design of a social unit in which recognition is given the necessity for a lowered per capita energy consumption.** Diedrich, R.A. (California State Univ., San Jose (USA)). Jun 1973. 136p. NTIS PC A07/MF A01.

As a means of closing the gap between insufficient energy reserves and an exponentially increasing demand, it is proposed that a program be sought which will bring about a reduction in demand. A technique which will produce such a program, while preserving the quality of life, is demonstrated. A systems approach is applied, covering the period from 1970 - 2000, and using a median nuclear family to monitor change. The total energy consumed by a U.S. family is broken down into several categories. A possible means of reducing energy use is selected from several alternatives according to chosen and weighted criteria. The changes proposed are then synthesized or combined with the existing family unit in light of expected social change. Thus, the cycle, being completed, can now be reiterated for a later time period. Three cycles are carried out for the years 1975, 1985, and 2000.

44985 (TID—28825) **Base data for the development of energy performance standards for new buildings. Phase one, task report: residential data collection and analysis, January 12, 1978.** (AIA Research Corp., Washington, DC (USA)). Oct 1978. Contract EX-76-A-29-1020. 117p. Dep. NTIS, PC A06/MF A01.

This report presents residential data collection and analysis undertaken for the U.S. HUD. The NAHB Research Foundation has developed base data on the designed energy performance of low-rise residential construction, including single family detached and single family attached homes, multi-family low-rise dwellings, and mobile homes in various climatic regions across the continental U.S. Data on energy-related building characteristics collected in a recent survey of single-family houses and low-rise multi-family residential construction in the last half of 1975 and the first half of 1976 were used for the residential analysis. A similar survey was conducted to document the production and energy-related construction characteristics of mobile homes. The data collected represents approximately 125,000 single-family homes, 45,000 multi-family low-rise units, and 175,000 mobile homes. Weather data were also compiled for each location where building data were collected. The technique used to estimate energy performance from the residential data was essentially a manual steady-state heat-transfer method which was computerized to reduce the processing time required for the large number of buildings. The annual energy performance of each building was estimated using building design data, heat loss and heat gain multipliers, and heating and cooling utilization factors.

44986 (UCRL-Trans—1568) **Ventilation requirements in one and multifamily houses.** Erikson, B.E.; Lofstedt, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Translation of Bulletin, Statens Institut for Byggnadsforskning (Klimatgruppen), unpublished, c1978, 8p. 10p. Dep. NTIS, PC A02/MF A01.

Results of a survey dealing with ventilation systems and ventilation requirements in one family and multifamily residences are summarized. Problems in connection with ventilation (condensation, drafts, etc.) are discussed and possible solutions are suggested. (JGB)

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 44931

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 44903, 44931

44987 (AD-A—057986) **Army energy management study.** (Unified Industries, Inc., Alexandria, VA (USA)). 31 May 1977. Contract MDA903-76-C-0392. 134p. NTIS PC A07/MF A01.

This report reflects the results of a management study to develop the optimum energy management organization for the Department of the Army (DA). Four specific tasks were addressed in the study. They were: (a) to determined what should be the roles and functions of the Army Energy Office, (b) to determine what organizational structure for energy management should be adopted at Headquarters, Department of the Army, (c) to determine what organization and functions should be required in major Army commands to best interface with the Department of the Army organization and (d) to recommend which changes to Department of the Army regulations and publications should be made.

44988 (AD-A—057987) **Army energy plan. Technical report.** Boas, R.J.; Conmy, J.B. Jr.; Tucker, H.W. (Unified Industries, Inc., Alexandria, VA (USA)). 24 Feb 1978. Contract DAAG39-77-C-0164. 176p. NTIS PC A09/MF A01.

The Plan identifies the Army's organization, goals, objectives, and policies with respect to energy. It projects energy consumption and costs to the year 2000 and summarizes the programs required to support the long range goals. A summary of current and needed energy related legislation is included. (Author)

TRANSPORTATION

44989 (PB—286491) **Transportation trends, issues and recommendations. Final report 1977.** (Missouri Office of Administration, Columbia (USA). Div. of Budget and Planning). Jan 1978. 36p. NTIS PC A03/MF A01.

The report is the culmination of research and other activities of the Missouri Transportation Policy Council Staff. It includes an analysis of transportation trends in the state and any potential shifting of loads from one mode to another. The report also comments on several areas of transportation financing and the present situation in Missouri. Recommendations for future transportation based programs and development activities are listed.

AIR AND AEROSPACE

REFER ALSO TO CITATION(S) 45055, 45056

44990 (N—78-29083) **Civil helicopter design and operational requirement.** Waters, K.T. (Boeing Vertol Co., Philadelphia, PA (USA)). Aug 1978. Contract NAS1-13624. 52p. NTIS PC A04/MF A01.

Design and operational requirements and other factors that have a restraining influence on expansion of the helicopter market are discussed. The needs of operators, users, pilots and the community at large are examined. The impact of future technology developments and other trends such as use, energy shortages, and civil and military helicopter requirements and development is assessed. Areas where research and development are needed to provide opportunities for lowering life cycle costs and removing barriers to further expansion of the industry are analyzed.

44991 (N—78-33087) **Preliminary design characteristics of a subsonic business jet concept employing laminar flow control.** Turriziani, R.V.; Lovell, W.A.; Price, J.E.; Quartero, C.B.; Washburn, G.F. (Vought Corp., Hampton, VA (USA). Technical Center). Sep 1978. Contract NAS1-13500. 48p. NTIS PC A03/MF A01.

Aircraft configurations were developed with laminar flow control (LFC) and without LFC. The LFC configuration had approximately 11% less parasite drag and a 7% increase in the maximum lift-to drag ratio. Although these aerodynamic advantages were partially offset by the additional weight of the LFC system, the LFC aircraft burned from 6 - 8% less fuel for comparable missions. For the trans-atlantic design mission with the gross weight fixed, the LFC configuration would carry a greater payload for 10% fuel per passenger mile.

44992 (N—78-33102) **Results and status of the NASA aircraft engine emission reduction technology programs.** Jones, R.E.; Diehl, L.A.; Petrash, D.A.; Grobman, J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1978. 53p. NTIS PC A04/MF A01.

The results of an aircraft engine emission reduction study are reviewed in detail. The capability of combustor concepts to produce significantly lower levels of exhaust emissions than present production combustors was evaluated. The development status of each combustor concept is discussed relative to its potential for implementation in aircraft engines. Also, the ability of these combustor concepts to achieve proposed NME and NCE EPA standards is discussed.

RAILWAY

44993 (PB—288259) **Amtrak: an experiment in rail service. Special report.** Mulvey, F.P. (National Transportation Policy Study Commission, Washington, DC (USA); Northeastern Univ., Boston, MA (USA)). Aug 1978. 211p. NTIS PC A10/MF A01.

The report analyzes the present and future contributions of the National Railroad Passenger Corporation (Amtrak) to the national transportation system. Chapter 1 reviews the major legislation affecting Amtrak and discusses Amtrak's program (labor, commissary, reservations, route expansion, etc.) with respect to the goals outlined by Congress. Chapter 2 analyzes Amtrak's performance in serving the national goals of safety, energy conservation, environmental protection, and provision of adequate service. The economic efficiency of the system is also analyzed. Chapter 3 examines possible future contributions of Amtrak to the same national goals between now and the year 1990. Chapter 4 offers a summary of the findings and some recommendations for restructuring the Amtrak system to reduce the operating deficit and maximize its contribution to national goals.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 45083

44994 (PB—284550) **Come together ridesharing program option summaries.** (Southern California Association of Governments, Los Angeles (USA)). May 1978. 57p. NTIS PC A04/MF A01.

The document provides technical summaries of the transportation options under consideration. These include (1) transportation facility improvements (e.g., exclusive lanes for high-occupancy vehicles; park and ride service; park-pool service), (2) non-facility transit service improvements (e.g., revised operation strategies, commuter bus service), (3) paratransit, (4) public sector information, legislative and administrative support, and (5) employer-incentive programs. These option summaries provide background material for identifying and evaluating strategies that encourage ridesharing.

44995 (PB—284585) **Monetization of transportation impacts: policy evaluation methodology. Final report.** Rock, S.M. (Illinois Univ., Chicago (USA). Urban Systems Lab.). Apr 1978. 138p. NTIS PC A07/MF A01.

The impacts of transportation investments are often measured in units that make comparisons difficult. Converting the units of an impact into equivalent dollar values (called monetization) will allow the combination of diverse effects measured in different inherent units. The result of this monetization process should provide additional objective and useful information in the decision-making process, and thus improve the analysis of investment alternatives. This report concentrates on those impacts that are relatively easy to monetize (travel time, energy use) and those impacts that are relatively difficult to monetize (pollution, accidents). Monetization for current values only is considered. The report consists of nine parts: an introduction and summary of the findings plus eight appendixes detailing the monetization process for a number of transportation impacts. The appendixes discuss the following: pollution, crime, accident costs, comfort, residential and business relocation, travel time and energy use.

44996 (PB—284780) **Shared ride services: a major opportunity, and an alternative way for people to get to work.** Shallbetter, C.; Herzberg, G.G. (Public Service Options, Minneapolis, MN (USA)). Jul 1975. 74p. NTIS PC A04/MF A01.

Public policy in the Twin Cities area is moving toward a conclusion that solution to transportation problems will require high-service, low-capital, cost-effective systems. Development of additional ways for people to get to work is, with the energy shortage, a matter of urgency in the area. The shared ride in small vehicles, or 'para-transit', has emerged as an attractive alternative to driving alone. The focus in developing alternatives to the automobile must be to determine which system - car or van pool, taxi, bus or other mass transit - is cost competitive with the automobile and best serves work trips going to specific locations. Small vehicle, door-to-door systems complement the system of large buses in serving the downtown area and could be additionally attractive for up to 40% of the estimated 830,000 daily work trips. The savings and benefits from a major effort at shared ride systems could be substantial for the employee, employer, and for the public. These low cost shared ride systems are available, but steps must be taken to resolve certain issues and make them more widely available.

44997 (PB—284835) **Transit bus propulsion systems propulsion requirements. Final report.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Transportation Consulting Div.). Jan 1978. 72p. NTIS PC A04/MF A01.

This is the second of four reports prepared under Project 3---Propulsion System Technology---of the overall Bus Technology Program. The purpose of Project 3 is to determine which propulsion

systems are feasible for use in TRANSBUS and to select systems suitable for alternative use during the life span of this model bus. The objective of this report is to furnish a rational basis and numerical procedure for assessing the power plant requirements of TRANSBUS, an advanced technology 40-foot urban transit motor coach. In this report power requirements for propulsion and accessory service of TRANSBUS are evaluated. Performance goals and specifications for TRANSBUS are reviewed, and those that influence the power requirements are identified. A range of vehicular and operational factors appropriate to the transit coach is considered. Using these factors, a likely model is assumed and its power requirements computed. The assumed parameters are varied within a reasonable range of values. These charts may be used to refine the power estimate as more complete data become available for selected vehicle components. Sensitivity of power requirements to each of the significant factors is analyzed in a series of charts. Typical power requirements on representative operating profile segments are also presented. The charts provide a frame of reference for the evaluation of the TRANSBUS prototype vehicle performance and for the consideration of alternative and advanced power plants. This report concludes that the estimated minimum power requirements for the standard specification TRANSBUS is 264 horsepower. This is compatible with the industry standard V-8 engine.

44998 (PB—286694) **Banfield high occupancy vehicle lanes. Final report.** (Oregon State Highway Div., Portland (USA)). Mar 1978. Contract DOT-FH-11-9127. 129p. NTIS PC A07/MF A01.

The report evaluates the operation of the High Occupancy Vehicle (HOV) lanes on the Banfield Freeway in the city of Portland, Multnomah County, Oregon. The report covers the HOV lanes impact on traffic flow, safety, modal shift, air quality, fuel savings and public attitude.

44999 (PB—286695) **Banfield high occupancy vehicle lanes. Appendices. Final report, 15 December 1975-1 July 1977.** (Oregon State Highway Div., Portland (USA)). Mar 1978. Contract DOT-FH-11-9127. 192p. NTIS PC A09/MF A01.

The first appendix provides the procedures used for monitoring the effects from installing high occupancy vehicle lanes on the Banfield Freeway in Portland, Oregon. The procedure includes study data collection forms, equipment required, personnel required, and task instruction. The studies include volume counts, occupancy counts, truck counts, travel time runs, bus ridership, park and ride lot usage, accidents analyses, and air quality monitoring. The appendices also include the summary of information gathered and the figures that were used to arrive at the conclusions in the main body of the report.

45000 (PB—288423) **Paratransit services.** Miller, G.K.; Glazer, L.; Courington, W.; Barnett, D.; Ross, S. (Transportation Research Board, Washington, DC (USA)). 1977. 75p. NTIS PC A04/MF A01.

Topics discussed include: Taxicab feeder service to bus transit; Commuter information system--A new ride-sharing tool; Impact of dial-a-ride on transportation-related energy consumption in small cities; Methodology for the analysis of local paratransit options; Satellite-city development through improved passenger transportation service; Planning process for the design of integrated fixed- and flexible-route bus service in Rochester; Findings of a study to estimate the effectiveness of proposed carpool-incentive policies; Transportation efficiency and the feasibility of dynamic ride sharing; Car-pooling programs: solution to a problem; Use of a quantitative marketing model to estimate impacts of car-pooling policies; Reductions in automobile use in four major cities as a results of car pooling and improved transit; Integrating transit and paratransit.

SEA AND WATER

45001 (PB—284590) **A practical operating guide for tuning steam turbine propulsion systems. Final report.** McCarthy, W.L. (Seaworthy Engine Systems, Inc., Essex, CT (USA)). 31 Jul 1978. Contract MA-7-38067. 284p. NTIS PC A14/MF A01.

This operating guide presents procedures, recommendations and guidelines for tuning marine steam turbine propulsion systems and related auxiliary components. Information relative to improving plant performance by optimized operation is included. Overall cycle performance analysis procedures are presented. Individual machinery component performance indicators have been identified. Penalties in excess fuel consumed due to operation in a degraded condition have been established. Component energy oriented problem cause, effect and corrective action matrices have been provided along with various reference curves and typical performance data. The guide concludes with a section on maintenance and performance analysis of basic shipboard instrumentation types.

PIPELINE

45002 (SAN—1171-1/5) **Slurry pipelines: economic and political issues. A review.** Banks, W.F. (Systems, Science and Software, La Jolla, CA (USA)). 30 Nov 1977. Contract EY-76-C-03-1171. 185p. (SSS-R—77-3023(Rev.1)). Dep. NTIS, PC A09/MF A01.

In the controversy surrounding the proposal to grant Federal eminent domain to coal-slurry pipelines, the fundamental issue is whether, on balance, such a grant is in the national interest. The principal subissues (peripheral issues) of economics, water supply and disposal, energy consumption and conservation, employment, safety, and environmental impact are analyzed. It is found that, as compared with unit trains, which are the only immediate alternative for movement of large quantities of Western coal, the pipelines are not against the national interest, except in the case of employment. It is concluded that, on balance, the pipelines are in the national interest and should be granted the power of Federal eminent domain.

INDUSTRY AND AGRICULTURE

45003 (DOE/TIC—10007) **Report of the proceedings of the Department of Energy workshop on energy conservation in the textile industry.** (Washington Scientific Marketing, Inc., DC (USA)). 24 Jan 1978. Contract W-31-109-ENG-38. 69p. Dep. NTIS, PC A04/MF A01.

The goal of the workshop was to identify opportunities of energy conservation research, development, and demonstration in the textile industry. John Rossmeissl, DOE, briefly described in his opening remarks at the workshop the operative structure of the Division of Industrial Energy Conservation and how industry interfaces with the Division's overall efforts. Additional papers presented and included here are: Energy Conservation in the Textile Industry, Optimization of Energy Usage in Textile Operations, and Foam Finishing and Dyeing Project. Four groups (Textile Energy Management Systems, Preparation and Dyeing, Finishing, and Textile Yarn and Fabric) conducted round table discussions and their deliberations and recommendations are presented. (MCW)

45004 (DOE/TIC—10778(Appendix)) **Energy efficiency improvement targets: Food and Kindred Products Industry appendix. Final report.** (Development Planning and Research Associates, Manhattan, KS (USA)). Jan 1977. 36p. Dep. NTIS, PC A03/MF A01.

This appendix to the report Energy Efficiency Improvement Targets for the Food and Kindred Products Industry amends original goals for specific segments of the food industry, e.g., beet sugar, pet food, etc., and presents flow diagrams of specific energy conservation measures in individual components of the industry. (LCL)

ENERGY SOURCES

45005 (CONF-790602—54) **Industrial applications of advanced energy systems.** Jones, J.E. Jr. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The author notes the greater efficiency of advanced energy systems in industrial applications than in the electric utility tranportation, or residential/commercial sectors. A broad—based assessment of industrial energy options based on coal and nuclear systems was completed at ORNL in 1975. This assessment led to further analyses of very high-temperature reactors for process applications and low-temperature process heat reactors. In coal systems, a comparison of advanced energy-conversion systems based on research and development experience and an assessment of the important factors restricting the use of coal in industry were recently completed. An atmospheric fluidized-bed combustion system for industrial cogeneration is under development, and a preliminary market assessment for the technology has been completed. 7 references. (MCW)

45006 (DOE/TIC—10625) **Energy efficiency improvement target for SIC 34 - Fabricated Metal Products.** Byrer, T.G.; Billhardt, C.F.; Farkas, M.S. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 15 Feb 1977. 35p. Dep. NTIS, PC A03/MF A01.

In accordance with section 374 of the Energy Policy and Conservation Act (EPCA), Pub. L. 94-163, the Federal Energy Administration (FEA) proposed industrial energy efficiency improvement targets for the ten most energy-consumptive manufacturing industries in the U.S. Following public hearings and a review of the comments made, the final targets for Fabricated Metal Products (SIC 34) were established and are described. Using 1972 data on the energy consumed to produce specific metal products, it was concluded that a 24% reduction in energy consumption for SIC 34 is a viable goal for achievement by 1980. (LCL)

45007 (DOE/TIC—10626) **Development and establishment of energy efficiency improvement targets for Primary Metal Industries: SIC 33. Final target documentation.** Lownie, H.W. Jr.; Maykuth, D.J.; McLeer, T.J.; Kura, J.G.; Varga, J. Jr.; Griffith, W.I. (Battelle

Columbus Labs., OH (USA)). 10 Mar 1977. 37p. Dep. NTIS, PC A03/MF A01.

In accordance with Section 374 of the Energy Policy and Conservation Act (EPCA), Pub. L. 94-163, the Federal Energy Administration (FEA) proposed industrial energy efficiency improvement targets for the ten most energy-consumptive manufacturing industries in the U.S. Following public hearings on December 9, 1976, and review of the written comments which were submitted to FEA, the final targets for Primary Metal Industries (Standard Industrial Classification 33) have been developed and are described. The primary metal industry includes the processing of steel, aluminum, copper, iron, lead, and zinc. A 9% decrease in net energy consumption in 1980 as compared with 1972 energy consumption in SIC 33 was concluded to be a technically feasible and economically practical goal. (LCL)

45008 (DOE/TIC—10636) **Energy efficiency improvement target for SIC 34 - Fabricated Metal Products.** Byrer, T.G.; Billhardt, C.F.; Farkas, M.S. (Battelle Columbus Labs., OH (USA)). 15 Mar 1977. 40p. Dep. NTIS, PC A03/MF A01.

A march 15, 1977 revision of a February 15, 1977 document on the energy improvement target for the Fabricated Metal Products industry (SIC 34) is presented. A net energy savings in 1980 of 24% as compared with 1972 energy consumption in SIC 34 is considered a realistic goal. (LCL)

45009 (DOE/TIC—10712) **Development and establishment of an energy efficiency improvement target for SIC 32 - Stone, Clay, and Glass Products. Final report.** Schorr, J.R.; Snyder, M.J.; Barr, H.W.; Duckworth, W.H.; Hooie, D.T.; Lennon, J.W.; Spinosa, E.D.; White, A.M. (Battelle Columbus Labs., OH (USA)). 10 Mar 1977. 44p. Dep. NTIS, PC A03/MF A01.

In accordance with section 374 of the Energy Policy and Conservation Act (EPCA), Pub. L. 94-163, the Federal Energy Administration (FEA) proposed industrial energy efficiency improvements targets for the ten most energy-consumptive manufacturing industries in the United States, and invited the oral and written presentation of views thereon by interested persons. Following public hearings and review of the written comments which were submitted to FEA, the final targets for Stone, Clay, and Glass Products (Standard Industrial Classification 32) have been developed and are described. A 16% reduction by January 1980 in SIC 32 as compared with energy consumption in 1972 was concluded to be technically and economically feasible.

45010 (DOE/TIC—10778) **Energy efficiency improvement targets: Food and Kindred Products Industry. Final report.** (Development Planning and Research Associates, Manhattan, KS (USA)). Jan 1977. 29p. Dep. NTIS, PC A03/MF A01.

The Energy Policy and Conservation Act (EPCA) Public Law 97-163, passed in Dec. 1975, required that FEA establish a program to promote increased energy efficiency in U.S. industry. This program includes the establishment of energy efficiency improvement targets for at least the ten most energy-consumptive industries. The Food and Kindred Products Industry Group (SIC 20) was identified as one of the major energy consuming manufacturing industries. Methods used to identify energy efficiency improvement possibilities in SIC 20 and its component industries, the technical and economic feasibility of such improvements, and the overall energy conservation achievable are discussed. It is concluded that a 12% net energy savings in 1980 as compared with 1972 energy consumption is a viable goal for the food industry. (LCL)

45011 (PB—287909) **Alternative electrical energy sources for maine. Summary report.** Jones, W.J.; Ruane, M. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1977. 554p. NTIS PC A24/MF A01.

An evaluation of eleven technologies as possible alternatives to the construction of a base-load type 600 MWe coal-fired generating plant, Central Maine Sears Island No. 1, in 1986 is presented. Considered alternatives are geothermal, ocean thermal, ocean and riverine current, wave, wind, and solar energy conversion; conservation; fuel cells; conversion of biomass and solid wastes; and the environmental impacts of these technologies.

45012 (DOE/TIC—10779(Vol.3)(Ch.4)(Pt.3)) **Energy consumption data base. Volume III, Chapter 4, Part 3. The chemical industry. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 1 Jun 1977. 371p. Dep. NTIS, PC A16/MF A01.

The chemical industry consumes the most energy within the manufacturing sector, using 5.2 quads (10^{15} Btu's) in 1974. This represents an average growth rate of 3.9% per year since 1967. Sixty percent of the energy was used as raw material feedstocks for conversion to derivative chemicals in 1967, but by 1974 these feedstocks made up less than half the total. Still, only two other manufacturing industries (Petroleum Refining and Primary Metals) used more energy for fuel purposes than the chemical industry used as feedstock alone in 1974. Natural gas is used most intensively in the chemical industry, making up 40% of the total energy consumed. About a quarter of this was used for feedstock purposes in 1974, and the rest for heat and power. LPG feedstock in chemical production is the next most important energy use, amounting to about one-fifth of the total. Miscellaneous petroleum products, mainly heavy liquid feedstocks, amount to about 15% of the total, followed by electricity, coal, and residual and distillate oil. Energy use is highly concentrated in the West South Central Census region. Nearly 60% of all energy consumed by the chemical industry is consumed here. Tabulated data are presented on regional energy consumption according to year and fuel type, and the method and computer codes used for computing this consumption is described. (LCL)

45013 (DOE/TIC—10779(Vol.3)(Ch.4)(Pt.2)) **Energy consumption data base. Volume III, Chapter 4, Part 2. Paper and allied products. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 31 May 1977. 104p. Dep. NTIS, PC A06/MF A01.

The U.S. paper industry consumed 2.2 quads of energy during 1974, one-ninth of the energy consumed in all manufacturing. Two aspects of the industry's fuel use pattern set it apart from other industries. First, 39% of its 1974 consumption came from renewable forest fuels rather than gas, oil or coal. These forest fuels, which accounted for only 33% of the industry's consumption in 1971, are made up primarily of spent black liquor containing lignins, resins, and nonrecoverable cellulose from the pulping process, but also are derived from bark and hogged wood which cannot be used for papermaking. Second, the paper industry consumes nearly one-third of all residual oil used in the manufacturing sector. Next to black liquor, residual oil was the most important source of energy for the paper industry in 1974, surpassing natural gas. The overall growth rate of energy consumption in the paper industry has averaged slightly better than 2% per year between 1967 and 1974, slowing to a 1/2% rate during 1971—1974. Among the data are regional consumption in the paper industry for converting and non-converting mills as well as the total of all mills by year and fuel type, regional expenditures at the same level of detail, and U.S. Btu consumption for the entire industry according to fuel type and functional use in 1974.

EQUIPMENT AND PROCESSES

45014 (COO—4649-4) **Energy conservation via heat transfer enhancement. Quarterly progress report, October 1, 1978—December 31, 1978.** Bergles, A.E.; Junkhan, G.H.; Webb, R.L. (Iowa State Univ. of Science and Technology, Ames (USA)). Mar 1979. Contract ET-78-S-02-4649. 21p. Dep. NTIS, PC A02/MF A01.

Progress on energy conservation via heat transfer enhancement for the period October 1, 1978 to December 31, 1978 is summarized. Eleven visits and meetings are noted along with five major industrial contacts. The Technical Literature File has been expanded by an additional 200 references and many hard copies. The Manufacturers' File is also being expanded. Details of the new patent file, to be centralized at Penn State, are described. The computerized retrieval file now contains 250 patents. A Patent Technology Report is planned. Progress in Application Area studies is described and new Technology Area studies are presented.

45015 (PB—288408) **Economic impact of fossil energy alternatives on California irrigated agriculture.** Johnston, W.E.; Adams, R.M.; King, G.A. (California Univ., Davis (USA). Water Resources Center). Jun 1978. 43p. NTIS PC A03/MF A01.

Some effects of alternative energy scenarios are analyzed for their short-run impacts on the level of production and the product mix of annual field crops and vegetables in California. The scenarios focus on the impacts of fuel and fertilizer cost increases and reduced supplies through a quadratic programming model of regional production of nine field crops and 28 seasonal vegetable crops. The short-run model considers soil type and water availability as constraints to the problem and in the case of water does not permit alteration in historical regional mixes of surface and ground water. Effects of the use of statewide versus regional energy allocations and of the introduction of an initial measure of producer risk are examined in model results. Price, quantity, acreage, and welfare effects are noted for the alternatives of regional energy allotments, increased energy prices, and statewide reductions in energy supplies. The welfare effects are examined in terms of changes in consumers' and producers' surpluses.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 44892, 44893, 44894, 44895, 44896, 44897, 44899, 44900, 44901, 44902, 44903, 44904

45016 (ORNL/SUB—79/42532) **Applications of thermal energy storage to waste heat recovery in the food processing industry. Final report.** Lundberg, W.L.; Christenson, J.A. (Westinghouse Electric

Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Jul 1979. Contract W-7405-ENG-26. 146p. Dep. NTIS, PC A07/MF A01.

A project is discussed in which the possibilities for economical waste heat recovery and utilization in the food industry were examined. Waste heat availability and applications surveys were performed at two manufacturing plants engaged in low temperature (freezing) and high temperature (cooking, sterilizing, etc.) food processing. The surveys indicate usable waste heat is available in significant quantities which could be applied to existing, on-site energy demands resulting in sizable reductions in factory fuel and energy usage. At the high temperature plant, the energy demands involve the heating of fresh water for boiler make-up, for the food processes and for the daily clean-up operation. Clean-up poses an opportunity for thermal energy storage since waste heat is produced during the one or two production shifts of each working day while the major clean-up effort does not occur until food production ends. At the frozen food facility, the clean-up water application again exists and, in addition, refrigeration waste heat could also be applied to warm the soil beneath the ground floor freezer space. Systems to recover and apply waste heat in these situations were developed conceptually and thermal/economic performance predictions were obtained. The results of those studies indicate the economics of waste heat recovery can be attractive for facilities with high energy demand levels. Small factories, however, with relatively low energy demands may find the economics marginal although, percentagewise, the fuel and energy savings are appreciable.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 44238, 45378

45017 (PB—286601) **Characteristics of secondary materials markets and their implications for resource recovery policy.** Coughlin, R.E.; Plaut, T.; Steiker, G. (Regional Science Research Inst., Philadelphia, PA (USA)). Mar 1978. 183p. NTIS PC A09/MF A01.

The regional econometric analysis of the wastepaper market and the interactive computer program for estimating potential supply of secondary materials are the two studies presented. The research objective was to investigate the nature of supply and demand forces underlying scrapmarkets which determine the extent of resource recovery and the effectiveness of any public programs to encourage recycling industry. The paper industry, which has for many years included an important recycling component, provided the focus. An econometric analysis of the markets for scrap paper was completed which indicates the form of the relevant supply and demand relationships. This analysis is unique in that it is carried out at the regional level as well as at the national level and because it includes the 1973-1976 time period which is noted as the time of an unprecedented peaking and subsequent decline in scrap paper prices. In addition, a simple-to-use interactive computer model was developed for estimating the potential scrap supply generated within a given area for which data are available on population and on economic structure and employment.

45018 **Recovery of aluminum and other metal values from fly ash.** McDowell, W.J.; Seeley, F.G. (to Dept. of Energy). US Patent Application 934,762. 17 Aug 1978. 11p.

The invention relates to a method for recovering aluminum from fly ash comprising mixing the fly ash with calcium sulfate or a mixture of calcium sulfate with a material selected from the group consisting of calcium carbonate, magnesium sulfate, or magnesium carbonate, sintering the resultant mixture at a temperature which will convert the fly ash to a crystalline structure, and then leaching the aluminum from the sintered mass with an aqueous inorganic acid.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 44868

45019 (CONF-790446—6) **Community heating and cooling systems.** Calm, J.M. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 4. annual heat pump technology conference; Stillwater, OK, USA (9 Apr 1979).

Approximately 78% of residential and 63% of commercial end-use energy consumption in the US is used for space and water heating and air conditioning. Heat Pump Centered Integrated Community Energy systems (HP-ICES) are promising approaches to meeting these needs while reducing resource consumption through the use of heat pump technology. Since these heat pumps primarily transfer energy from existing and otherwise probably unused sources rather than convert it from electrical or chemical to thermal form, HP-ICES offer significant potential for energy conservation. Furthermore, since conventional building heating and cooling systems would be replaced by this community energy system, non-scarce resources could be used instead of depleting fuels which are in short supply. This is accomplished by powering the heat pumps with non-scarce energy forms not practical for use in the smaller conventional systems. Secondary benefits expected to enhance the value of HP-ICES include reduction of adverse environmental effects, reliable production of services in view of increasingly frequent utility curtailments and interruptions, and provision of services at costs more favorable to consumers. Centralized, distributed, and cascaded HP-ICES approaches are discussed, and an analysis showing their conservation potential is presented. The DOE sponsored HP-ICES Project and interim results are also presented.

CONSERVATION SERVICES

REFER ALSO TO CITATION(S) 44905, 44910, 45028

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 44892, 44893, 44896, 44898, 44899, 44900, 44901, 44902, 44904, 44905

45020 (PB—288046) **Resource analysis: water and energy as linked resources.** Lounsbury, M.; Hebenstreit, S.; Berry, R.S. (Illinois Univ., Urbana (USA). Water Resources Center). Aug 1978. 210p. NTIS PC A10/MF A01.

An evaluation is made of the energy required to supply and treat water, rather than the water requirements of energy production. The primary energy requirements for three sectors of water management--municipal water supply, municipal sewage treatment, and water for irrigation--are evaluated. Six major cities, Chicago, Denver, Los Angeles, New Orleans, San Antonio, and St. Louis, are used as indicators of the national trend in energy requirements to supply water to municipalities. Nationwide data provided by the federal Environmental Protection Agency for 1977 and 1990 are used to determine the rate of change of energy required to treat municipal sewage over this period. The energy required to supply water for irrigation is estimated for three regions in the Southwest: Kern County, California; the Texas high plains; and San Carlos, Arizona.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 44615, 44715, 45017

45021 (PB—284659) **Thermodynamic data for waste incineration. Report for 1 January 1975—31 December 1976.** Domalski, E.S.; Evans, W.H.; Jobe, T.L. Jr. (National Measurement Lab. (NBS), Washington, DC (USA). Chemical Thermodynamics Data Center). Aug 1978. 169p. NTIS PC A08/MF A01.

A table of thermodynamic data of 331 selected materials has been compiled for the purpose of providing engineers with information on materials which are not easily identifiable by a stoichiometric formula. Examples of such materials are: foods, wood species, oils, animals, plants, polymers, etc. The table is arranged alphabetically according to the names of the various materials, and whenever possible, the chief components or all readily identifiable components are supplied. In addition, the physical state, the kind of thermodynamic property, specific-property values, and citations to a list of 142 references are furnished. In order to assist the reader with finding a specific material or property, a material name and property index has been put together. A section on Units and Definitions explains the various thermodynamic properties being reported and the condition under which they apply. An appendix supplies auxiliary information on symbols for thermodynamic quantities, units, physical constants and atomic weights. The table is oriented more toward engineers involved in the disposal of municipal wastes than any other group; however, applications in other engineering and scientific sectors can easily be made.

45022 (PB—286688) **Total energy consumption for municipal wastewater treatment.** Smith, R. (Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab.). Aug 1978. 52p. NTIS PC A04/MF A01.

Quantities of all forms of energy consumed for collection and treatment of municipal wastewater are estimated. Heat energy is equated to electrical energy by a conversion factor of 10,500 Btu/kwh. Total energy consumption, expressed as kwh/mg of wastewater treated, ranges from 2300-3700 kwh/mg. Energy used for construction of the treatment plant and the seweage system represents 35-55% of the total energy consumed. The remainder used for plant operation is predominately (65-75%) electrical energy. The use of high efficiency aeration devices combined with good maintenance practices appears to offer the best opportunity for conservation of energy within the plant.

EDUCATION AND PUBLIC RELATIONS

45023 (PB—286625) **Consumer response to urban drought in central California. Final report.** Bruvold, W.H. (California Univ., Berkeley (USA). School of Public Health). Jun 1978. 82p. NTIS PC A05/MF A01.

The report assesses consumer attitudes toward residential water conservation programs adopted by nine selected San Francisco Bay Area water districts; and evaluates the effectiveness of the water conservation programs mounted by the selected Bay Area water districts considering differences between residential water restrictions among districts. Methodology included scientific sampling to select respondents, and personal interviews. The major finding from the research was that rationing or conservation plans should be based upon number of people, not the previous year's use, average yearly use, size of lot, or ability to pay. Such a conservation program means that water purveyors would have to obtain, and continually update, information on the number of people served by each service connection. This would require a complicated and costly billing process, but if it were to be the basis of a long term conservation effort, the benefits would outweigh the initial costs. The study also recommends that any rationing or conservation program be strictly enforced. Tabular and graphic material is included.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

45024 (CONF-7805102—(Summ.), pp 3-8) **Implications of the Automotive Research and Development Act of 1978 (Title III, Public Law 95-238).** Brogan, J.L. (Dept. of Energy, Washington, DC). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Information is provided about some recent Federal legislation and how it is expected to influence the ongoing Federal program which is being reviewed during this conference. The law is entitled the Automotive Propulsion Research and Development Act of 1978, or Public Law 95-238.

45025 (CONF-7805102—(Summ.), pp 419-422) **Overview of Vehicle Systems Project.** Lombardi, P.V. (Dept. of Energy, Washington, DC); Baughman, L.E. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Jet Propulsion Laboratory has responsibility for the Vehicle Systems Project with overall program management residing with the Transportation Energy Conservation (TEC) Division of the Department of Energy. The objectives of the program are to: analyze and assess technology for highway vehicles with a systematic review of advanced propulsion systems that meet this nation's goals for energy conservation and environmental protection; research and develop the technologies necessary to encourage manufacturers to produce highway vehicles that meet the Nation's goals; and evaluate and demonstrate advanced technologies that are being developed to help speed their incorporation in highway vehicles. Automotive technology status and projections as well as social and economic assessments of impact of advanced engines are part of the systems analysis and evaluation. It is planned to make annual assessments. Vehicle engineering and test will be performed on automobiles, trucks, and buses, as well as demonstrations of these vehicle systems. Paper studies and evaluation tests will be made of advanced concepts, including new invention ideas in transports. Advanced subsystems technology R & D involve predominantly hardware for waste heat utilization, advanced transmission, and accessories for advanced engines.

45026 (CONF-7805102—(Summ.), pp 423-440) **Review of Automotive Technology Status and Projections Project.** Dowdy, M.W. (Jet Propulsion Lab., Pasadena, CA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The major thrust of the Automotive Technology Status and Projections Program (ATSP) is the assessment of the potential of advanced alternative heat engine power systems (Brayton and Stirling) when compared with the evolving conventional power systems (UN Otto, Diesel, and SC Otto). Factors considered in the study include fuel economy, exhaust emissions, multi-fuel capability, use of advanced materials, and cost manufacturability. Experimental and theoretical data on these factors are presented. (LCL)

45027 (PB—286906) **Automobile marketing strategies, pricing, and product planning. Final report, March—September 1977.** Siegel, H.M.; Burrows, T.M.; LaCivita, C.J. (ASL Engineering, Inc., Goleta, CA (USA)). Aug 1978. Contract DOT-TS-13632. 83p. NTIS PC A05/MF A01.

The United States automobile industry is analyzed from the viewpoint of how current procedures inhibit or prevent the increased manufacture and sales of U.S. cars that are more efficient with respect to fuel economy. Suggestions and recommendations are made as to how some of the obstacles may be overcome.

45028 (PB—286910) **Study of consumer automotive preference with regard to fuel economy measures. Final report, July 1977-May 1978.** Green, P.E.; Rogers, P.W. (Rogers National Research, Inc., Sylvania, OH (USA)). Sep 1978. Contract DOT-TSC-1391. 50p. NTIS PC A03/MF A01.

An analysis is made of the effects of size and weight reduction of 1977 General Motors standard size cars. A buyer profile describing demographic characteristics, age, sex, education, marital status, size of family and income by make is prepared for 1976 and 1977 General Motors standard size cars, and 1977 Ford Motor Company and Chrysler Corporation cars. The analysis focuses on testing whether significant differences exist between the average attitudinal, behavioral, and demographic profiles of two a priori defined groups - buyers of downsized and buyers of non-downsized cars. Multivariate analysis determined the variables that were the major discriminants. It is shown that attributes related to fuel economy are important discriminants distinguishing buyers of downsized standards from non-downsized standard size cars. Those who purchased the downsized cars did so with expectations (that were fulfilled) of better fuel economy, as well as increased maneuverability and ease of parking. They reinforced the pursuit of fuel economy by also choosing 6-cylinder engines and manual transmissions to a greater extent. Share of market, market composition, source of sales, and owner loyalty are discussed. It is concluded that the General Motors Corporation downsizing of its standard size cars was a significant fuel economy measure and a success in the market place as well.

INTERNAL COMBUSTION ENGINES

45029 (CONF-7805102—(Summ.)) **Highway vehicle systems: contractors coordination meeting. Fourteenth summary report.** (Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation). Sep 1978. 685p. Dep. NTIS, PC A99/MF A01.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Sixty-two papers were presented at the meeting. A separate abstract was prepared for each of 61 papers. One paper was previously abstracted for the data base. (LCL)

45030 (CONF-7805102—(Summ.), pp 484-492) **Waste heat utilization study for trucks.** Leising, C.J. (Jet Propulsion Lab., Pasadena, CA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objectives of the Waste Heat Utilization study are to identify and evaluate various options for utilizing waste heat in truck engines; calculate possible improvement in the fuel economy; and compare options on a common basis. These studies concluded that: diesels should be turbocharged and after-cooled to the maximum possible; Rankine engine bottoming cycle will improve diesel performance by 12% over driving cycle; turbocompounding will improve diesel performance by 4% over driving cycle; Rankine engine compounding and turbocompounding provide about the same improvement per dollar; significant improvements in turbocompounding may be possible by increased turbocharging, increased compressor and turbine efficiencies, or more efficient utilization of blowdown energy; development of an adiabatic diesel will improve effectiveness of waste heat utilization devices by up to 300%; Rankine engine compounding looks attractive for gas turbines and, if costs could be reduced, for spark ignition; regeneerating a spark ignition engine shows significant potential; and not much improvement is possible for Stirling engines. (LCL)

SPARK-IGNITION

45031 (N—78-34007) **Evaluation of FIDC system. Final report.** Hall, R.A.; Dowdy, M.W.; Price, T.W. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Oct 1978. Contract NAS7-100. 132p. NTIS PC A07/MF A01.

A fuel vapor injector/igniter system was evaluated for its effect on automobile engine performance, fuel economy, and exhaust emissions. Improved fuel economy and emissions, found during the single cylinder tests were not realized with a multicylinder engine.

Multicylinder engine tests were conducted to compare the system with both a stock and modified stock configuration. A comparison of cylinder-to-cylinder equivalence ratio distribution was also obtained from the multicylinder engine tests. The multicylinder engine installed in a vehicle was tested on a chassis dynamometer to compare the system with stock and modified stock configurations. The fuel vapor injector/igniter system (FIDC) configuration demonstrated approximately 5% improved fuel economy over the stock configuration, but the modified stock configuration demonstrated approximately 12% improved fuel economy. The hydrocarbon emissions were approximately 230% higher with the FIDC system than with the stock configuration. Both the FIDC system and the modified stock configuration adversely affected driveability. The FIDC system demonstrated a modest fuel savings, but with the penalty of increased emissions, and loss of driveability.

45032 (PB—287871) **Heavy duty fuel economy program, phase iii. transient cycle evaluations of the advanced emissions control technology engine. Final report.** Urban, C.M. (Southwest Research Inst., San Antonio, TX (USA)). May 1978. 190p. NTIS PC A09/MF A01.

The report describes the laboratory effort toward further evaluating the emissions and fuel economy performance of the advanced emissions control technology engine configuration optimized in Phase II of this project. An additional intent of Phase III was to obtain data toward establishing a linking mechanism between data generated previously using various different operating cycles and test procedures. Project tasks included: examination and overhaul of the engine used during Phase II, nine-mode and transient cycle emissions and fuel consumption evaluations, and recommendations for future work. For the transient cycle evaluations, which included light-duty FTP and experimental CAPE-21 cycles, the engine was installed into an appropriate heavy-duty truck. All transient cycle emissions and fuel consumption evaluations were conducted on a heavy-duty chassis dynamometer and utilized a truck-size constant volume sampler.

45033 **Closed loop exhaust gas recirculation control system.** Schira, J.J.; Toelle, A.D.; Phipps, J.R. (to Bendix Corp.). US Patent 4,142,493. 6 Mar 1979. Filed date 29 Sep 1977. 58p.

A closed loop exhaust gas recirculation (EGR) control system is described for an internal combustion engine having an intake system, an exhaust system, a throttle disposed within the intake system for controlling air flow therein, a conduit coupling the exhaust system to the intake system for supplying exhaust gas back to the intake system for controlling the generation and emission of oxides of nitrogen and for improving drivability and avoiding engine roughness. The EGR control system includes a first memory pre-programmed with a look-up table of optimal EGR values indicative of EGR valve position or the like determined as a function of engine speed and throttle position and a second memory pre-programmed with the look-up table of optimal EGR values determined as a function of engine speed and absolute manifold pressure. The actual operating parameters of engine speed, throttle position and absolute manifold pressure are accurately sensed and stored as multi-bit binary numbers or words. The most significant bits (MSB) of the words are used to address the first and second memory while the least significant bits (LSB) of the words are used to perform a double linear interpolation of the accessed values to compute accurate first and second EGR values. The second EGR value is substracted from the first EGR value to determine a difference indicative of the current EGR valve error. A previously computed and stored EGR error value used to determine the last valve position adjustment is then subtracted from the current EGR error value to determine the total change in error value required to correct the EGR valve position at the next adjustment. The updated EGR error value is converted into a control signal which is used to adjust the position of the EGR valve at the next scheduled valve adjustment time so as to regulate EGR flow as desired.

DIESEL

45034 (CONF-7805102—(Summ.), pp 441-451) **Status report on diesel organic—Rankin compound engine for long-haul trucks.** Doyle, E. (Thermo Electron Corp., Waltham, MA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The purpose of this program is to develop and demonstrate a completely integrated compound engine, consisting of a diesel engine coupled to a Rankine engine which operates on the exhaust heat from the diesel engine. The prototype compound engine is being built around a standard Mack Truck diesel engine, and the waste heat recovery system is an organic Rankine bottoming cycle engine incorporating a turbine expander delivering power to the diesel engine drive train. A pre-prototype compound engine has been designed, fabricated, and assembled for test on a dynamometer. This status report covers the work performed from October 1977 to April 1978. During this period of time, dynamometer tests have been conducted on the pre-prototype compound engine. The initial test results are presented. Separate tests have also been performed on some key components such as the turbine and feed pump. Redesign of the bottoming cycle system to incorporate new packaging concepts and improved component designs for the prototype truck installation have been completed and the components are being fabricated. A Mack F-Model sleeper cab has been selected for the test vehicle. The cab has been assembled and is now being modified for installation of the bottoming cycle components.

45035 (SAND—79-8210) **Carbon particulate measurements in a diesel engine.** Keeton, S.C. (Sandia Labs., Livermore, CA (USA)). Jun 1979. Contract EY-76-C-04-0789. 42p. Dep. NTIS, PC A03/MF A01.

Various optical techniques are considered for counting and sizing soot particles in the combustion chamber of diesel engines. Imaging and single-particle methods are not applicable because the majority of light scattering by the distribution of particles resulting from diesel combustion comes from particles which are too small for those techniques. Many-particle scattering techniques, such as extinction and right angle scattering, show promise. Measurements using these methods may have to be restricted to after top dead center because of the large quantity of liquid fuel being injected before that point. Multiple particle light scattering may also prevent measurements for maximum expected soot mass concentrations with the extinction technique. Many-particle scattering techniques will generate quantitative particle sizing information only if the particle diameter distribution function and index of refraction are known for the soot system being studied. The use of several laser wavelengths separated by at least several hundred Angstroms, however, would allow the use of a distribution function with several unknown parameters.

TURBINE

REFER ALSO TO CITATION(S) 45079

45036 (CONF-7805102—(Summ.), pp 9-14) **Heat Engine Systems Program.** Krasner, M.H. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The goals, scheduling, funding, and status of automotive gas turbine and automotive Stirling engine research programs at the NASA Lewis Research Center are reviewed. (LCL)

45037 (CONF-7805102—(Summ.), pp 15-16) **Department of Energy Automotive Gas Turbine Program overview.** Mercure, R.A. (Dept. of Energy, Washington, DC). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The DOE/NASA Automotive Gas Turbine Program involves work on improved engines and advanced engine concept definitions. Eight subjects pertinent to this program which are discussed at this meeting are listed. (LCL)

45038 (CONF-7805102—(Summ.), pp 16-22) **Gas Turbine Project status.** Goette, W.E. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The organization, status, and fiscal year 1978 accomplishments of the Automotive Gas Turbine Research Program at the NASA Lewis Research Center are summarized. (LCL)

45039 (CONF-7805102—(Summ.), pp 22-46) **Status of Corrective Development Program on Chrysler upgraded engine.** Wagner, C.E. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Since 1973 the Chrysler Corp. has been engaged in a program to upgrade its automobile gas turbine. The first upgraded engine was performance tested in July 1976 and the results showed that the turbomachinery section would have to be redesigned to meet program goals. Progress is reported on the corrective development phase of this program which involves compressor development, power turbine redesign, turbine section redesign, compressor turbine development, thrust bearing and gas bearing development, and engine—vehicle system development. (LCL)

45040 (CONF-7805102—(Summ.), pp 46-66) **Status of ceramic component and durability development for the gas turbine engine.** Rockwood, F.A. (General Motors Corp., Detroit, MI). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Current activities in a program to develop and evaluate ceramic components for vehicular gas turbine engines are reviewed. At this point in the program, engine testing has resulted in over 1000 h on silicon carbide nozzle vanes, 102 h on a silicon nitride tip shroud, and over 3000 h on aluminum silicate regenerator disks at an engine operating temperature of 1900°F. In addition, initial materials characterization is being conducted on reaction-bonded silicon carbide, sintered silicon carbide, reaction-bonded silicon nitride, and sintered silicon nitride. Components of alternative materials for the vane and tip shroud are now undergoing rig component tests in preparation for early engine evaluation. During the next report period, emphasis will be on continued testing at 1900°F while design and process development activities for the 2070°F configuration are conducted.

45041 (CONF-7805102—(Summ.), pp 66-83) **Tests of advanced single-shaft, variable-geometry engine (AGT-2).** Johnson, R.A. (General Motors Corp., Detroit, MI). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The single-shaft engine is one of the candidate types for turbine engine application to passenger cars. Wide range variable-geometry components allow construction of cycles with outstanding part-power SFC characteristics. The existing AGT-2 engine incorporates both of these features and was selected for use in a characterization test program. The engine and facility have been prepared for testing which is scheduled to start in late May 1978. Test results and data analysis will be presented at the next meeting.

45042 (CONF-7805102—(Summ.), pp 83-92) **In-House Test Program on turbomachinery components at NASA Lewis Research Center.** Wong, R.Y. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objective of this program is to support the Upgraded Engine Development Program by providing: aerodynamic components which have the potential to meet performance goals and automotive related constraints, such as driveability, low cost fabrication, etc.; and component test data that can be used in diagnosing engine performance problems. The scope of this effort is to build component test rigs and make component tests of each component. These components include the compressor, compressor drive turbine, power turbine, interstage ducting, and downstream diffuser all provided from the Chrysler Ungraded Engine Program. The results of tests on the compressor and compressor drive turbine are presented.

45043 (CONF-7805102—(Summ.), pp 92-111) **Development of compliant foil bearings for automotive gas turbines.** Gray, S. (Mechanical Technology, Inc., Latham, NY). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Mechanical Technology Incorporated (MTI) has designed, developed, and delivered Hydresil compliant hydrodynamic foil journal air bearings for the Chrysler/DOE automotive gas turbines which have been operational for over 1-1/2 years. The design of the 1-1/2" diameter foil bearing and the location of the bearing in the gas generator are shown. The gas generator rotor, which operates in the speed range of 30,000 rpm at idle to nearly 60,000 rpm at full speed, is supported on the foil journal bearing at the hot turbine end at a temperature of 500°F and on a smaller, rigid, oil-lubricated journal bearing at the compressor end. Currently MTI is engaged in delivering bearings, the examination of tested bearings, and the introduction of improvements in some specific areas based on engine operation experience on the test stand and in the car. This work is summarized and discussed. Some of the supporting technology work on materials, coatings and thrust bearings is also reviewed.

45044 (CONF-7805102—(Summ.), pp 111-133) **Preliminary data from NASA Lewis Research Center testing of Chrysler gas turbine regenerator.** Winter, J. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The purpose of this experimental work was to study the performance of the regenerator system of the Chrysler Upgraded Gas Turbine. The Chrysler Upgraded Engine uses a ceramic rotary regenerator to recover exhaust heat from the turbine to improve performance and fuel consumption. Testing of the Chrysler Upgraded Engine indicated that the power was below design and the specific fuel consumption was above design rating. In order to investigate possible reasons for the discrepancies and to develop an understanding of automotive heat exchangers, a general purpose test facility was designed and constructed. The Chrysler ceramic rotary regenerator system was the first heat exchanger tested in the facility and these tests were the only full-scale hot regenerator system tests of this Chrysler component. Data from these tests may be used to screen and select regenerator system modifications for inclusion in engine testing.

45045 (CONF-7805102—(Summ.), pp 133-155) **Processing technology and evaluation of duo-density ceramic turbine rotors.** Baker, R.R. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Duo-density silicon nitride rotors for vehicular gas turbines fabricated in 1977, by a process developed partially under DOE funding, have shown a significant improvement in cold spin reliability over the state-of-the-art rotors fabricated in 1975. Hot test results (of 1977 vintage rotors) in both hot spin rigs and engines are very encouraging in that the first attempt to complete a 200-h rotor durability test was successful. Ceramic turbine rotors have now been run at turbine inlet temperatures of 2000 to 2500°F at speeds of 27,000 to 50,000 rpm for periods up to 200 h. Process improvements in injection molding were identified with the addition of a Hunkar flow control unit which resulted in eliminating subsurface voids in the inner, more highly stressed portion of the blades. Microfocus x-ray techniques were developed to produce magnified x-rays in addition to radial view panoramic x-rays of the rotor blade ring rim. Degradation of reaction-bonded silicon nitride blade rings, which occurred during hot press bonding, was found to be controllable. The all-ceramic turbine rotor has now joined the ceramic stationary components which previously had demonstrated 200 h durability. A major integrated program is now needed to design and demonstrate high efficiency ceramic turbines and to develop ceramic materials and processes for long durability and high reliability.

45046 (CONF-7805102—(Summ.), pp 156-162) **Status of Ford Ceramic Regenerator System Development Program.** Rahnke, C.J. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Data accumulated in the last six months in the program for evaluating ceramic regenerators for vehicular gas turbines continues to show that two materials, aluminum silicate (AS) and magnesium aluminum silicate (MAS), have the potential of achieving the program objective of a B_{10} life of 10,000 h at 800°C. To date, none of the eighteen AS or six MAS cores that have been engine tested show any serious signs of chemical attack damage. Two AS cores have each accumulated over 7000 h. A problem still exists in elastomerically bonding a ring gear to a thin-wall AS core. One thin-wall core with a high compliance elastomer design has accumulated 4000 h without distress, but a bigger sample is needed before any conclusion can be reached. A thick-wall AS core has now accumulated 5000 h at 982°C without damage. Full-size, second generation MAS cores, of improved material composition, are now on engine test. Other new materials are now undergoing laboratory and engine screening tests for chemical attack resistance and elevated temperature capability.

45047 (CONF-7805102—(Summ.), pp 163-168) **Automotive Gas Turbine Ceramic Materials Program overview.** Blankenship, C.P. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Key elements in the DOE/NASA Heat Engine Highway Vehicle Systems Project include improved and advanced gas turbine propulsion systems and advanced system component technology. Ceramic material technology development is a major program element under the advanced system component technology portion of the project. All hot flow path components in advanced systems are expected to require ceramic materials in order to operate at turbine inlet temperatures near 2500°F. For ceramic components, fabrication technology is a key area of development that will require substantial efforts for components such as rotors and heat exchangers. Component reliability and cost-effectiveness will be emphasized as they are the most important factors in the application of ceramics to automotive systems. The structure of the ceramic materials program covers: materials characterization; improved materials development; and component development. The status of research studies in each of these fields is reviewed.

45048 (CONF-7805102—(Summ.), pp 168-179) **Current status of life prediction methodology for ceramics.** Lenoe, E.M. (Army Materials and Mechanics Research Center, Watertown, MA). Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

For the past two years, AMMRC has conducted ceramic materials research under the sponsorship of DOE-TEC for the Gas Turbine Program. These studies have involved general support, as requested by the Division of Transportation Energy Conservation, and have also focused on three tasks: Task I - Development of Sinterable Si_3N_4; Task II - Proof Testing Methodology; and Task III - Durability Testing of Structural Ceramics. Recent accomplishments of Tasks I and III are reviewed briefly and the progress on Task II is presented.

45049 (CONF-7805102—(Summ.), pp 179-186) **Silicon carbides for DOE/NASA Sponsored Automotive and Industrial Gas Turbine Programs.** Kraft, E. Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Carborundum Company is developing two silicon carbides for use as high performance engineering materials. Sintered alpha silicon carbide is produced by pressureless sintering of submicron alpha SiC powder. Fine-grained reaction-sintered SiC is produced by liquid silicon infiltration of a compact of SiC and C powders wherein the silicon reacts with the C forming a SiC + Si bond between SiC particles. The materials and processes used for producing these silicon carbides and the fabrication of gas turbine components from these ceramics are briefly described. (LCL)

45050 (CONF-7805102—(Summ.), pp 186-190) **Ceramic oxide/heat exchanger materials.** McCreight, L.R. Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

GE-3200 is a 60:40 mixture of lithium aluminum silicate:magnesium aluminum silicate (LAS:MAS) with very favorable processing characteristics due to the use of two phases. These are the mineral petalite and a synthetic cordierite frit, respectively. While the performance in many laboratories, as well as in actual engine tests, was excellent, thermal stability and cold face (sodium chloride exposure) test results were not as favorable. Two general approaches to overcome these deficiencies were briefly studied. First, heat treating studies and cycling tests were performed seeking to thermally stabilize the honeycomb structure. Secondly, compositional variations based on using spodumene for the LAS phase were tried aimed at improving the corrosion resistance. The tests of GE-3200 as reported here, while not yet completely definitive, suggest that thermal treatments can provide greater stability. In addition, modified compositions offer some potential improvement in thermal expansion, thermal stability, and corrosion resistance which warrant further honeycomb fabrication and testing. Even greater improvements in materials for automotive heat exchangers appear to be possible based on modified cordierite. The compositions under study have given preliminary indications of excellent thermal stability and corrosion resistance for use at temperatures over 1100°C. It is planned to prepare a fullscale regenerative heat exchanger wheel from one of these compositions by fall.

45051 (CONF-7805102—(Summ.), pp 190-200) **Aluminum silicate heat exchanger materials.** Lanning, J. Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objective of the Corning program is to develop a rotary ceramic regenerator core which will maximize its potential for: high temperature operation; high durability; high thermal efficiency; low cost; and low pressure drop. The scope of the program covers materials development, fabrication technology, cell configuration, and structure testing. The design and durability testing of aluminum silicate cores and future work in this program are discussed. (LCL)

45052 (CONF-7805102—(Summ.), pp 200-212) **Ceramic recuperative heat exchanger.** Krauth, A. Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Research on ceramic technology for recuperative heat exchangers and gas turbine components is discussed. Data are presented on the mechanical strength, permeability, and thermal properties of SiC, SiN, and aluminium silicate, and aluminium titanate. (LCL)

45053 (CONF-7805102—(Summ.), pp 453-460) **Demonstration and evaluation of gas turbine engines in urban transit coaches.** Chesnes, A.A. (Dept. of Energy, Washington, DC). Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The overall program objective is to provide the transportation industry with performance and operational data on gas turbine propulsion systems in heavy-duty, stop-and-go revenue operations, such as for city buses. A specific goal of the program is to provide the nation's transit authorities with a viable alternative to conventional coach propulsion systems consistent with coach and engine availability. The program organization and schedule are presented.

45054 (CONF-7805102—(Summ.), pp 461-463) **Greyhound/DOE Turbine-Powered Intercity Bus Demonstration Program.** Bade, N.E. Sep 1978.
From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The plan for road testing gas turbines installed in four standard intercity Greyhound buses is described. The major subjects to be investigated are fuel economy and reliability. (LCL)

45055 (N—78-29103) **Long-term CF6 engine performance deterioration: evaluation of engine S/N 451-380. Final report.** Kramer, W.H.; Smith, J.J. (General Electric Co., Cincinnati, OH (USA). Aircraft Engine Group). Aug 1978. Contract NAS3-20631. 112p. NTIS PC A06/MF A01.
The performance testing and analytical teardown of CF6-6D engine serial number 451-380 which was recently removed from a DC-10 aircraft is summarized. The investigative test program was conducted inbound prior to normal overhaul/refurbishment. The performance testing included an inbound test, a test following cleaning of the low pressure turbine airfoils, and a final test after leading edge rework and cleaning the stage one fan blades. The analytical teardown consisted of detailed disassembly inspection measurements and airfoil surface finish checks of the as-received deteriorated hardware. Aspects discussed include the analysis of the test cell performance data, a complete analytical teardown report with a detailed description of all observed hardware distress, and an analytical assessment of the performance loss (deterioration) relating measured hardware conditions to losses in both specific fuel comsumption and exhaust gas temperature.

45056 (N—78-29105) **Effect of steady flight loads on JT9D-7 performance deterioration.** Jay, A.; Todd, E.S. (Pratt and Whitney Aircraft, East Hartford, CT (USA). Commercial Products Div.). 9 Jun 1978. Contract NAS3-20632. 103p. NTIS PC A06/MF A01.
Short term engine deterioration occurs in less than 250 flights on a new engine and in the first flights following engine repair; while long term deterioration involves primarily hot section distress and compression system losses which occur at a somewhat slower rate. The causes for short-term deterioration are associated with clearance changes which occur in the flight environment. Analytical techniques utilized to examine the effects of flight loads and engine operating conditions on performance deterioration are presented. The role of gyroscopic, gravitational, and aerodynamic loads are discussed along with the effect of variations in engine build clearances. These analytical results are compared to engine test data along with the correlation between analytically predicted and measured clearances and rub patterns. Conclusions are drawn and important issues are discussed.

45057 **Multistage axial turbine.** Bradbury, J.H. (to Bradbury Inventions Proprietary Ltd., Highgate Hill (Australia); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,628,933/A/. 5 Jan 1978. 8p. (In German).
This turbine is meant to transmit 'a part of the molecular energy of motion of water, air or gas on the driving shaft'. The turbine output is to be produced as a product of the number of stages, e.g. 4 or more, and the output which is equal in each stage. The flow crossection over the whole axial length is constant in order to maintain the same torque in each stage with the same speed and quantity of flow, i.e. the housing and the rotor are of cylindrical shape, all fixed blades and all moving blades have the same shape and are at angles of 90° to each other with blade angles of 45°. A relatively small pressure gradient between the inlet and the outlet maintains a high velocity of flow.

ROTARY

45058 **Rotary piston machine with parallel and internal axes.** Molly, H. (to Sperry Rand Corp., Troy, MI (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,050,161/C/. 19 Jan 1978. 5p. (In German).
In this rotary piston machine, e.g. a geared pump, the hollow internal gear is to be movable to some extent but also protected sufficiently against deformation. The cylindrical casing of this engine contains, within the hollow gear, a spur gear having got e.g. the double diameter of the hollow gear, external toothing of the gears,

and being supported in the casing at crescent-shaped filling body, rigidly connected with the casing, is filling the space between the two gear wheels. In the space between the inner diameter of the casing and the outer diameter of the hollow gear there is placed an elastic metallic filling ring with rectangular cross-section. Sealed underpressure fields on the inside and the outside of the filling ring are connected to the section space of the engine. They become attached to the hollow gear and the casing by section. In this way the hollow gear is protected against unidirectional high-pressure loading.

EXTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 45029, 45030

45059 (CONF-7805102—(Summ.), pp 8-9) **Review of heat engine systems objectives.** Brogan, J.L. (Dept. of Energy, Washington, DC). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

An overview of the DOE Heat Engines Systems Program is presented which summarizes the goals and anticipated benefits of the program. (LCL)

STIRLING CYCLE

REFER ALSO TO CITATION(S) 45036

45060 (ANL-K—78-3983-1) **Road vehicle thermal energy storage concept and evaluation: phase I. Final report, January—October 1978.** Waters, E.D. (Sigma Research, Inc., Richland, WA (USA)). Dec 1978. Contract W-31-109-ENG-38. 179p. Dep. NTIS, PC A09/MF A01.

A conceptual design has been developed for a thermal energy storage system that will adequately power a Stirling engine for highway vehicle propulsion. A lithium magnesium fluoride eutectic with a melting point of 741°C is used to store 102.4 kWh of energy over the temperature range of 600 to 825°C. A two-phase liquid metal (potassium) is required to attain the heat transfer rates. A cobalt-containing alloy (Inconel 617) provides adequate creep rupture strength at operating temperatures for the 10-year design life. The present concept includes recharge by electric resistance heating. The system design was developed within the specified size and weight restraints of 0.4 m^3 and 500 kg, respectively.

45061 (CONF-7805102—(Summ.), pp 213-217) **Stirling Engine Project status.** Ragsdale, R.G. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Two major industry efforts are now underway to develop an improved Stirling propulsion system. One of these development activities is being conducted by Ford Motor Company. The other development activity is being conducted by a contractor team composed of Mechanical Technology Incorporated, as the prime contractor, and United Stirling of Sweden and AM General as major subcontractors. Work toward an advanced propulsion system includes a design study of a Stirling general-purpose test engine and publication of a design analysis manual that summarizes currently available Stirling analysis techniques. Advanced component technology activities are in progress in the discipline areas of materials, seals, lubrication, combustors, small research engine testing, and computer model validation. The Stirling engine team presently includes eight industry and university participants. The status of this project is outlined. Plans for the coming six months include completion of the fuel economy assessment by Ford, completion of a Stirling technology assessment by the MTI team, and completion of the design study of a general-purpose test engine. It is also planned to initiate work on ceramic recuperator fabrication technology and on advanced heater head conceptual designs.

45062 (CONF-7805102—(Summ.), pp 217-231) **Ford Stirling engine powertrain development.** Kitzner, E. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

In September 1977, the Ford Motor Company completed contract negotiations with the Government for a cost-shared automotive Stirling Engine Development Program. The purpose of the program is to establish manufacturing feasibility for a production automotive Stirling engine and provide sufficient information for the automotive industry to decide whether a production program for the Stirling engine should be initiated. The first task in this program is a fuel economy assessment of the automotive Stirling engine. Efforts on this task, which is now 50% complete, are described. The results so far show that: the confidence level for meeting the 20.6 mpg fuel economy objective has increased from 30 to 53%; that over 140 h of variable-load running has been accumulated on one engine; and the durability of the 4-215 Stirling engine has been significantly increased. (LCL)

45063 (CONF-7805102—(Summ.), pp 231-238) **Present Philips Program, 4-215 DA Stirling engine.** Spigt, C.L. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

A joint feasibility study was initiated in 1971 between N.V. Philips of Eindhoven, The Netherlands, and Ford Motor Company, United States, to determine whether a Stirling engine could be packaged in a passenger vehicle. The results of the feasibility study were positive and a long-term agreement between Ford and Philips was signed on July 15, 1972. This agreement included three major elements: a Phase I program during which Philips, with Ford's assistance, would design, build, and test on dynamometers a 170 horsepower Stirling engine, and install the engine in a 1975 Torino for further testing and development. This engine is marked as the 4-215 DA engine; a Phase II program during which Ford, with Philips' assistance, would further develop a passenger car Stirling engine through the preproduction stage; and a licensing agreement. Philips activities in determining the temperature distribution and gas flow patterns in the engine, the effect of the power control system on fuel consumption, methods of reducing conductive heat losses, and plans for future activities in the program are discussed. (LCL)

45064 (CONF-7805102—(Summ.), pp 238-259) **MTI Stirling engine powertrain development.** Decker, O. (Mechanical Technology Inc., Latham, NY). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Mechanical Technology Incorporated (MTI) has been awarded a contract from NASA to develop an automotive Stirling engine. MTI, as prime contractor, will be responsible for program management and business development, component and analytical tool development, technology transfer, and licensing. United Stirling of Sweden (USS) will develop and supply the engines and AM General (wholly-owned subidiary of American Motors Corporation) will be responsible for integration of the engine into United States vehicles. A United States engine manufacturer will be selected to design, develop, and manufacture the Stirling engine in the USA. The program, which will span 7-1/2 yr, is dedicated to the development of an automotive Stirling engine and the transfer of Stirling engine technology to a United States engine manufacturer. The program goals are to develop and characterize a preproduction Stirling engine system so that a United States automobile manufacturer, in the 1985—1986 time period, can decide whether to undertake a production program for a Stirling engine powered automobile and to transfer Stirling engine technology to a United States engine manufacturer. Task objectives and their time schedules are outlined.

45065 (CONF-7805102—(Summ.), pp 259-295) **In-vehicle Stirling engine operational experience.** Rosenqvist, K. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

United Stirling of Sweden (USS) has been testing a 30 kW V4 Stirling engine in a Ford Taunus station wagon and a 65 kW V4 engine in a Volvo F406 delivery truck. The characteristics of the engines, and their performance in terms of efficiency, acceleration, starting power, fuel consumption, driveability, noise, exhaust emissions, and cooling requirements are discussed. The Stirling vehicles had good reliability, low number of gear shifts in traffic, excellent low speed characteristics, fast acceleration, low noise and exhaust emissions, low vibration level, and multi-fuel capability. It is concluded that the Stirling engine can successfully compete with any internal combustion engine. (LCL)

45066 (CONF-7805102—(Summ.), pp 295-305) **Lewis Research Center Stirling Engine Test Program.** Tomazic, W.A. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Lewis Research Center engine test program for the DOE Stirling Engine Program has the goals of: developing and validating a comprehensive Stirling engine simulation computer code; providing data on engine component performance; and providing an independent evaluation of Stirling engines developed under other contracts. This Stirling Engine Test Program is now well underway. A single cylinder, rhombic drive engine is now in test, primarily to provide data for development of an independent engine simulation

computer code. A test cell is being prepared to test the United Stirling P-40 engine which should be delivered early in 1979. The preliminary design contract for the GPTE is half completed and delivery of the first engine is expected in late 1979. Initial work on preparing a test cell for large Stirling engines (80 kW and above) has begun. (LCL)

45067 (CONF-7805102—(Summ.), pp 305-322) **Design of a Stirling general-purpose test engine.** Auxer, W. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Stirling General-Purpose Test Engine (SGPTE) is being designed which will have high reliability and versatility over a wide range of test conditions. It will also have the capability of permitting components of different designs to be tested interchangeably. Specifications for the engine and drive system are presented. The recommendation of a U-configured engine employing a split rhombic drive has been accepted for the SGPTE preliminarty design. The gaseous fuel fired, porous plate burner has been selected as the separable heat source. (LCL)

45068 (CONF-7805102—(Summ.), pp 322-330) **Advanced automotive Stirling concept.** Meijer, R. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The status of an N.V. Philips' project to determine the fuel economy potential of a Stirling engine-powered 3500 lb automobile is described. This project required using only existing Stirling technology and a front wheel drive automobile with a transverse engine. It is reported that a combined metro-highway cycle fuel economy of 40 mpg is attainable. (LCL)

45069 (CONF-7805102—(Summ.), pp 330-333) **Putting it all together.** Beremand, D.G. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The goals for fuel economy and exhaust emissions in the Improved Engine program are reviewed, and plans for testing and evaluating Stirling combustor technology are outlined. (LCL)

45070 (CONF-7805102—(Summ.), pp 335-338) **Engine performance analysis development.** Valentine, H.H. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Stirling engines offer the potential for delivering power at higher efficiency and with lower emissions than conventional internal combustion heat engines. In addition, their multi-fuel capability offers the promise of significantly reducing future demands for high quality petroleum fuels. The DOE is currently engaged in a number of programs aimed at the application and advancement of Stirling engine technology to serve a variety of power producing needs. At the present time, the largest of these programs is the Stirling Engine Highway Vehicle Systems Program. One facet of this DOE program is the development of analytic programs to aid in the design, development, evaluation, and optimization of Stirling engine hardware. The long range objective of the Stirling Engine Analysis Effort is to make available, in the open literature, validated computer programs to aid in the design, development, and optimization of Stirling engine systems. At the present time, the results of the effort are expected to be embodied in two comprehensive computer programs. The first of these is a detailed engine simulation program which is expected to be capable of accurately predicting the performance of real engine hardware over its full range of operation. The second program is expected to enable optimization of Stirling engine systems to maximize and/or minimize specified physical and/or performance characteristics within given system constraints. Since, in the optimization process, literally thousands of engine variations may be generated, it is necessary that the optimization program be structured about a simplified engine performance model to avoid excessive computer execution times. At present the NASA-Lewis engine performance program is operational.

45071 (CONF-7805102—(Summ.), pp 339-343) **Stirling engine design analysis manual.** Martini, W.R. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

A Stirling engine design manual which summarizes current developments and points to useful future developments is in the process of publication. It contains information on: current large engines; design methods; theoretical and experimental data; sample design procedure; references; and a directory. (LCL)

45072 (CONF-7805102—(Summ.), pp 343-358) **Evaluation of reciprocating seals for Stirling cycle engine application.** Curulla, J.F. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

It is necessary that the development of the Stirling cycle engine include research and development to provide an effective rod sealing system that will maintain internal gas pressure, minimize heater contamination due to excessive oil leakage, reduce internal friction, and have long life capability. A program to define applicable seals and to test the two potentially best candidates has been awarded to The Boeing Company by NASA Lewis Research center. This program has progressed to the initiation of the endurance testing for the first candidate seal to be evaluated. The Boeing Foot Seal is the first configuration to be evaluated while the NASA Chevron polyimide seal evaluation will follow. The accomplishments of this past reporting period include: (1) completion of the design and fabrication of the seal testing apparatus, (2) selection and approval of an acceptable gas leakage and oil leakage criteria, and (3) design and fabrication of the Chevron polyimide seal.

45073 (CONF-7805102—(Summ.), pp 358-366) **Pumping ring analysis.** Keith, T.G. (Univ. of Toledo, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

A numerical study of the transient performance characteristics of an oil pumping ring in a Stirling engine is currently underway. The overall objectives of this study are: to advance understanding of the pumping ring operation; to produce an experimental means of corroborating the computer predictions; and to develop a digital computer program which can be utilized in the design and selection of seal components. A digital computer program which can be used to determine pumping ring performance has been developed. However, the program has not been completely verified, for it produces results that are not always in complete agreement with the published experimental results. These differences are currently being examined and the problems should be resolved shortly.

45074 (CONF-7805102—(Summ.), pp 367-372) **Analysis of rod seal lubrication for Stirling engine application.** Krauter, A.I. (Shaker Research Corp., Ballston Lake, NY). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objectives of this program which started in February 1978 are: application of hydrodynamic and elastohydrodynamic theory to a sliding elastomeric rod seal for the Stirling engine; experimental determination of film thickness, fluid leakage, and power loss; and correlation of the experimental and theoretical results. The analytical effort consists of two analyses: an approximate analysis of rod seal behavior at the four extreme piston position/piston velocity points and a detailed temporal analysis of the seal behavior during a complete piston cycle. Analytical work performed to date indicates that: the oil flow through the seal/cylinder interface is dominated by Couette rather than by Poiseuille flow; the minimum film thickness at the maximum velocity portion of the stroke will be at least eight micro-inches; the squeeze film effect at the ends of the piston stroke is strong so that the variation of film thickness throughout the cycle may be expected to be small; and a mechanism may exist to eliminate net cyclic oil flow. The experimental work performed to date indicates that interferometry fringes can be produced for an oil-filled gap between coated glass and some types of optically smooth rubber. Current work in this area concerns producing interference fringes for those elastomers anticipated for use in the engine. Current work on the design of the experimental apparatus concerns producing detail drawings of the component parts.

45075 (CONF-7805102—(Summ.), pp 373-379) **Stirling Materials Technology Program.** Stephens, J.R. (Lewis Research Center, Cleveland, OH). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

In support of the DOE/NASA Heat Engine Highway Vehicles Systems Program, the NASA Lewis Research Center is currently conducting a materials research and technology effort with the purpose of providing materials support for the Stirling engine systems program. This program is focused on high temperature components of both the improved (metal) and advanced (ceramic) Stirling engines. Primary emphasis is placed on heater head tube materials and the companion problems associated with hydrogen containment and compatibility. The program is divided into three major areas of research: materials characterization; improved materials; and fabrication technology. Progress and plans for future work in this program are described.

45076 (CONF-7805102—(Summ.), pp 380-388) **Hydrogen permeability of ceramics and metals.** Yates, D. (IIT Research Inst. Chicago, IL). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Stirling engine has been identified as a possible long-term alternative for the power plant of automotive vehicles. One of the critical materials areas is the heater head assembly, with anticipated operating conditions of a hydrogen working fluid at 3000 psi and a wall temperature of approximately 1400°F. The heater head material must be able to contain the working fluid by having a high resistance to hydrogen permeation. Investigations are required to evaluate the resistance to hydrogen permeation of various uncoated and coated superalloys suitable for this application. A research program on this subject has been divided into four tasks. Task I requires the determination of permeability, diffusivity, and solubility of hydrogen in four iron-base superalloys (Incoloy 800, N155, 19-9-DL, and A286) tested in 3000 psi hydrogen over the temperature range of 1200 to 1500°F. Task II involves determination of the permeability of hydrogen in N155, coated with four individual hydrogen barrier coatings to include Si_3N_4, a glass coating, an aluminide coating, and a high density Al_2O_3 coating. Task III involves determination of the permeability of hydrogen in the three remaining superalloys from Task I coated with the optimum coating from Task II. Task IV will be directed toward determining the permeability of five ceramic materials tested in 3000 psi hydrogen at 1800°, 2000°, and 2200°F. These ceramics include hot-pressed silicon nitride (containing 8 v/o Y_2O_3), reaction-sintered silicon carbide, and siliconized silicon carbide. A test facility for this research has been constructed and is undergoing reliability and safety trials.

45077 (CONF-7805102—(Summ.), pp 388-405) **Thermo electron conceptual design study of thermal energy storage for a Stirling car.** Morgan, D. (Thermo Electron Corp., Waltham, MA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Stirling engines for automotive propulsion have a number of potentially important advantages including very high efficiency. The Stirling engine can be used with thermal energy storage, potentially eliminating or reducing the use of minimum petroleum or synthetic liquid fuels for automotive propulsion. In this program, a conceptual design of a complete Thermal Energy Storage (TES) system for a Stirling engine-powered car is being developed and its characteristics are being determined. The TES system is based on the use of inorganic salts with a high latent heat of fusion. The criteria for TES material selection are listed. Lithium fluoride and sodium fluoride salts are the prime candidate materials. Information is presented on their cost and characteristics and the conceptual design of a TES unit. Further research must be done to determine the cost of construction materials, development of a reliable TES module structure with vacuum tightness and the ability to withstand vacuum/pressure, and the means of recharging the TES unit from combustion heat sources external to the vehicle. (LCL)

45078 (CONF-7805102—(Summ.), pp 405-417) **Sigma Research conceptual design of thermal energy storage for a Stirling engine highway vehicle.** Waters, E.D. (Sigma Research, Inc., Richland, WA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Various previous studies have indicated the feasibility of thermal energy storage/heat engine systems for highway vehicle propulsion and have established system preliminary parameters and requirements. The objectives of the present program are to: develop a conceptual design of a 105kWh to 200 kW peak power system; provide an engineering analyses of the thermodynamic and material performance; and develop bases for determining the economic/strategic acceptability. Information is included on TES compatability with a crankshaft or swashplate drive engine, TES configuration, effects of TES capsule size, insulation system, control system, materials considerations, and expected performance. The work to date shows that the TES system heat transfer performance can meet all requirements for energy supply to a Stirling engine highway vehicle. Economic trade-offs are presently underway and the indications are that the TES system could be quite competitive with alternate systems. (LCL)

45079 (CONF-7805102—(Summ.), pp 498-513) **Advanced engine accessory study.** Lefferts, C. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The general objective of the accessory program was to define, evaluate, and develop automotive accessory systems to reduce engine power consumption and to significantly improve fuel economy. The program was initiated in June 1974 and successfully completed in April 1978. Both existing and advanced engine accessory systems were studied, and basic concepts to improve performance and fuel economy were recommended. The major program effort produced a variable ratio belt accessory drive and demonstrated fuel economy improvement of 4 to 10%. The hybrid accessory drive and advanced air conditioning study expanded the constant speed and accessory load matching concepts to include engine waste heat and braking regeneration to further improve fuel economy. Advanced Stirling and gas turbine accessory requirements were defined. The automotive accessory system program has produced energy conservative accessory system concepts for near-term and advanced applications. The trend toward lighter vehicles with small, higher speed engines requires accessory power conservation to obtain fuel economy goals of the future.

RANKINE CYCLE

REFER ALSO TO CITATION(S) 45034

ELECTRIC-POWERED SYSTEMS

45080 (DOE/CS—0026-6) **Electric and hybrid vehicle program. Quarterly report, April—June.** (Department of Energy, Washington, DC (USA)). May 1979. 24p. Dep. NTIS, PC A02/MF A01.

Progress in US programs on the design, development, production, and performance testing of electric-powered and hybrid electric-powered vehicles is briefly summarized.

45081 (N—78-29992) **Preliminary power train design for a state-of-the-art electric vehicle. Final report.** Mighdoll, P.; Hahn, W.F. (Booz, Allen and Hamilton, Inc., Cleveland, OH (USA). Design and Development Div.). Apr 1978. Contracts NAS3-20595;EC-77-A-31-1044. 144p. NTIS PC A07/MF A01.

Power train designs which can be implemented within the current state-of-the-art were identified by means of a review of existing electric vehicles and suitable off-the-shelf components. The affect of various motor/transmission combinations on vehicle range over the SAE J227a schedule D cycle was evaluated. The selected, state-of-the-art power train employs a dc series wound motor, SCR controller, variable speed transmission, regenerative braking, drum brakes and radial ply tires. Vehicle range over the SAE cycle can be extended by approximately 20% by the further development of separately excited, shunt wound dc motors and electrical controllers. Approaches which could improve overall power train efficiency, such as AC motor systems, are identified. However, future emphasis should remain on batteries, tires and lightweight structures if substantial range improvements are to be achieved.

45082 (PB—284419) **The amount of vehicle operation over 50 mph. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Jul 1978. 23p. NTIS PC A02/MF A01.

Vehicle operational characteristics, especially driving speeds, affect fuel economy. When driving speed exceeds 45 mph, fuel economy decreases. This report presents current information on the amount of vehicle operation at speeds greater than 50 mph.

45083 (PB—284366) **An investigation of a battery-trolley bus system.** Weeks, R. (Transport and Road Research Lab., Crowthorne (UK)). [nd]. 27p. NTIS PC A03/MF A01.

A feasibility study of a combined battery and trolley bus system has been carried out. The double-decked 80-passenger electric bus has a performance compatible with modern traffic. It is powered from overhead wires for only part of its route. For the remainder of its journey, it uses lead-acid batteries which are recharged from the overhead supply when the bus next reaches a powered route section. The likely cost and weight of the bus components were investigated and possible technical, environmental, and safety problems were considered. Systems studies were carried out for two urban areas. It was concluded that the system could be made to work satisfactorily in most towns which now have an urban bus system, without significant changes to existing timetables. There would be some improvement in air pollution and noise over diesel buses, but no saving in primary energy or running costs. The capital cost of the system would be much higher than that for a diesel bus fleet.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 45080

VEHICLE DESIGN FACTORS

REFER ALSO TO CITATION(S) 45029

45084 (CONF-7805102—(Summ.), pp 492-498) **Controlled Speed Accessory Drive (CSAD) Demonstration Program.** Courville, G. (Jet Propulsion Lab., Pasadena, CA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

DOE and the General Service Administration (GSA) have agreed to a cooperative project to test and evaluate a new technology which offers the potential of improved fuel economy for passenger vehicles. This project entails the test and evaluation of a Controlled Speed Accessory Drive System (CSAD) for passenger automobiles. A prototype variable ratio drive has been designed and built to replace the fixed-ratio water pump drive conventionally used on automobiles. Information and data supplied to DOE indicated that a ratio drive has potential for a fuel economy improvement of 5 to 10% when compared to conventional fixed-ratio drives. The CSAD acts to operate the accessories at a nearly constant, more optimum speed, for most engine speeds. The fuel economy improvement results from a reduction of the horsepower used to drive the water pump and the engine-powered accessories. The controlled speed accessory drive consists of a pair of centrifugally controlled variable pitch belt pulleys mounted on the crankshaft and water pump of the engine. The water pump pulley serves as the output drive and is the power take-off for the engine accessories. As the engine speed increases, the drive ratio decreases resulting in the slower than stock accessory speeds which reduces parasitic losses and improves the fuel economy. The main objective of this program is to evaluate the improved fuel economy resulting from the installation of CSAD's on passenger automobiles under actual driving conditions. The program plan and schedule are presented.

ENGINE-TRANSMISSION MATCHING

45085 (CONF-7805102—(Summ.), pp 464-483) **Hydromechanical transmission development for passenger car fuel economy improvement.** Pratt, J. Jr. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The design, operation, control system and performance testing of a continuously variable transmission (CVT) for application to automobiles are described. The results show that the Orshansky Transmission Corporation has improved the fuel economy of a 232 CID 6 cylinder American motors sedan 20% by installing an electronically controlled continuously variable hydromechanical transmission. The fuel savings have been realized due to the fine degree of control the transmission has in serving the engine on a srict best-fuel-economy speed schedule. This fine degree of control is only possible with a transmission having a wide ratio spread and stepless shifting. A second generation transmission is currently being designed. It will use the new Ph IV Back-to-Back Co-Axial Hydrostatic Module. The transmission design has improved efficiency in the high overdrive ratios. The size and weight of the second generation hydromechanical transmission will be comparable to a current production three-speed automatic transmission, representing a 39% and 42% reduction, respectively, relative to the first generation transmission. (LCL)

EMISSION CONTROL

REFER ALSO TO CITATION(S) 45033

45086 (PB—286703) **Evaluation of restorative maintenance on 1975 and 1976 light-duty vehicles in San Francisco, California.** (Automotive Environmental Systems, Inc., Westminster, CA (USA)). Oct 1977. Contract EPA-68-03-2439. 243p. NTIS PC A11/MF A01.

A study of exhaust emissions was performed in Westminister, California, to determine the relationship of emissions levels to the maintenance condition of the vehicles. The test fleet consisted of 100 San Francisco area consumer-owner 1975-1976 model-year passenger cars equally represented by the three major U.S. automobile manufacturers. All vehicles were tested using the 1975 Federal Test Procedure. Additional tests included Highway Fuel Economy Tests and several short-cycle tests. Each vehicle was tested initially in the as-received condition. Various stages of restorative maintenance and retesting were then performed in an attempt to bring failing vehicles into compliance with 1975/1976 California standards. Selected vehicles were also subjected to a series of specified maladjustments or disablements in order to evaluate the individual and combined effects of these conditions on emissions and fuel economy. (Portions of this document are not fully legible)

45087 (PB—288399) **An evaluation of restorative maintenance on exhaust emissions from 1975/1976 in-use automobiles in California. Technical report.** Farrell, P. (Environmental Protection Agency, Ann Arbor, MI (USA)). Oct 1978. 24p. NTIS PC A02/MF A01.

The paper describes the results of emissions testing on one hundred 1975-76 Model Year vehicles in California conducted by the U.S. EPA from March 1977 to Jan. 1978. The vehicles were moderate-mileage models of three major domestic manufacturers. Each was obtained randomly from private individuals and was subjected to a series of tests before and after various stages of tune-up. The findings confirm the poor initial pass-rate of in-use vehicles and the ultimate ability of most vehicles to meet their applicable standards once maladjustments and disablements have been corrected. In comparing these results with those of 49 state vehicles in an identical program, the California vehicles exhibited lower absolute emission levels but were quite similar when displayed in relation to their more stringent standards.

SULFUR DIOXIDE

45088 (NTIS/PS—78/1235) **Sulfate emissions from automobiles (citations from the Engineering Index Data Base). Report for 1964-November 1978.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1978. 72p. NTIS PC N01/MF N01.

The bibliography of worldwide citations pertains to the sulfates exhaust emissions from automobiles. The topics cover the control equipment used, the chemistry, the relationship of sulfur oxides and sulfates, control equipment design and effectiveness, and the environmental impacts. The updated bibliography contains 67 abstracts, 10 of which are new entries to the previous edition.

PARTICULATES

REFER ALSO TO CITATION(S) 45035

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 44460, 45029

45089 (CONF-7805102—(Summ.), pp 531-537) **Identification of probable automotive fuels composition 1985—2000.** Russell, R.A. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objective of this program was to develop a methodology to project fuel composition for future automotive use. The approach was to select reference resources, i.e., coal and oil shale, investigate their conversion to syncrude, establish future engine requirements, and determine possible refinery modifications. The program organization and the roles of the participants are outlined. The criteria used in selection of coals and oil shales were (1) adequacy in meeting production demands by the year 2000 and (2) representative compositions of domestic coals and shales. (RCK)

45090 (CONF-7805102—(Summ.), pp 537-539) **Hybrid fuels.** Moses, C.A. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objectives of the hybrid fuels program are to identify, develop, and demonstrate hybrid fuels for the transportation sector. Petroleum fuels will continue to be in short supply, consequently, they will need to be replaced by hydrocarbons from syncrude or also possibly supplemented by other sources of hydrogen and carbon such as alcohols. The two problems that need to be considered are (1) these other sources are not ready to be brought on stream and (2) hydrocarbons from syncrude will require more refining to produce transportation fuels. (RCK)

45091 (CONF-7805102—(Summ.), pp 540-543) **Automotive hydrogen storage with magnesium hydride.** Rohy, D.S. (Solar Turbines International, San Diego, CA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

On-board fuel storage is a basic limitation to the use of hydrogen as an automotive fuel. Metal hydrides can store hydrogen at the same volumetric density as cryogenic methods, but generally incur serious weight penalties. Among the relatively common materials, magnesium-base alloys offer the best (lowest) weight density. The objective of this program is to develop a magnesium-base alloy

to store hydrogen that meets the operating constraints of a conventional automobile with a spark ignition engine. This subject is discussed under the following topics: (1) hydride system constraints, (2) hydride selection, (3) cost of hydride energy storage, and (4) reduction in dissociation temperature. It is concluded that hydrogen storage in metal hydrides is a viable concept for automotive applications and that modified magnesium alloys are the best for this application among known alloys. (RCK)

45092 (CONF-7805102—(Summ.), pp 543-550) **Survey of liquid hydrogen container technology for highway vehicle fuel system applications.** Escher, W. (Escher Technology Associates, St. Johns, MI). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

A survey of liquid hydrogen container technology applicable to highway vehicle on-board containment is described. The objectives of the survey were to assess cryocontainer technology, identify and document specific hydrogen while container projects, and provide rough estimates of automotive fuel system production costs. The general findings of the survey are listed. At this point, the state-of-the-art remains immature in terms of high-production liquid hydrogen containers for highway vehicle applications. (RCK)

45093 (CONF-7805102—(Summ.), pp 550-556) **Hydrogen Engine Performance Analysis Project.** Adt, R.R. Jr. (Univ. of Miami, FL); Swain, M.R. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Baseline data for throttled and unthrolled, carburetted, hydrogen engine configurations with and without exhaust gas recirculation (EGR) and water injection were gathered during the first year of the project. The testing program used was formulated to address in detail the two major problems that must be overcome if hydrogen-fueled engines are to become viable, i.e., flashback and large NOx emissions at high loads. Some of the results found during the present study are presented.

45094 (CONF-7805102—(Summ.), pp 556-562) **Alternative fuels for intercity trucking systems.** Foster, R.W. (Escher Technology Associates, St. Johns, MI). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

There are a significant number of non-petroleum based alternative fuel systems applicable to intercity trucking operations. These systems were studied on a laboratory engine basis. It is believed that the optimum design of engines for use with these fuel systems has not yet been determined. Many design, development, and manufacturing problems must be solved before such fuels can be tested in intercity trucking equipment. (RCK)

45095 (CONF-7805102—(Summ.), pp 562-568) **Dept. of Energy Alcohol Fuels Program.** Ecklund, E.E. (Dept. of Energy, Washington, DC). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Department of Energy conducted an internal review of activities on alcohol fuels and established an alcohol fuels program. There were a number of coordinated activities, but these were not comprehensive. Recognizing the growing, broad interest of the public and Congress, DOE made a commitment to Congress to review these internal activities and to determine what might be done. As a result, an Alcohol Fuel Task Force was established. The Task Force was charged with the following responsibilities: plan comprehensive, coordinated program; recommend DOE position; and recommend organizational responsibility. Alcohols are one of several options. The Task Force examined: role of alcohols, supply potential, production and use technologies, and existing and planned activities. The results of this study are contained in a position paper, "Executive Summary of Program Plan." The key point is that there are major questions/uncertainties which obstruct policy decision. The document presents information on: current status, action for short-term resolution of policy, and positive, coordinated program with expanded baseline and new action on existing technology.

45096 (CONF-7805102—(Summ.), pp 568-576) **Effects of blending alcohol with gasoline on automotive engine steady-state performance and regulated emissions characteristics.** Adt, R.R. Jr. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

An experimental study was performed to determine the effects of substituting an alcohol—gasoline blend for gasoline on the steady-state performance and emissions characteristics of a carbureted spark-ignited engine. In the study, three fuels were tested: a base stock of unleaded gasoline (viz. Indolene); a 20% blend of methanol in Indolene; and a 20% blend of ethanol in Indolene. The impact of the alcohol-containing fuels on engine performance and emissions characteristics was statistically inferred, the inference being based on previously performed statistical analysis of Indolene vis a vis 20% methanol-Indolene bland data. For fixed engine conditions (engine speed, fuel—air equivalence ratio, manifold vacuum, MBT spark advance), the performance and emissions characteristics during 20% ethanol blend-fueled operation were found to fall between those found using the 20% methanol blend fuel and those found using the pure Indolene fuel. Comparing the 20% methanol blend with the Indolene data, it was found that: engine torque was approximately 2% greater with the blend, there was at most an approximately 1.7% rise in brake thermal efficiency, CO emissions were the same, NOx and FID HC emissions were found to decrease with the blend. From these results, it is concluded that, for the same engine conditions, the substitution of practical level alcohol blends (10 to 15% by volume) will have little effect on steady-state performance and currently regulated emissions (CO, FID HC, NOx) characteristics.

45097 (CONF-7805102—(Summ.), pp 576-587) **Alternate Fuels and Data Bank Program.** Stamford, K. (Dept. of Energy, Bartlesville, OK). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Recent activities at BERC in the area of alternate fuels utilization in transportation applications are described. These activities include: a series of 10% ethanol/gasoline fleet tests; an investigation of the physical composition of two-phase gasoline/methanol/water solutions; and an alternate fuels data bank designed to provide current information concerning research activities and developments in the area of utilization by transport vehicles. The 10% methanol blend fleet studies are designed to provide information concerning the near-term possibility of using methanol to extend the conventional petroleum based supplies. The effects of methanol blend fuels can only be determined by extended vehicle use (approximately 50,000 miles) on the alcohol/gasoline blend. The ethanol fleet tests are of a shorter duration. The current physical properties investigation is concerned with the phase separation characteristics of gasoline/methanol/water systems. Previous work established the base for determination and the factors contributing to phase separation. The composition of the solutions after phase separation has already occurred is being investigated. The alternate fuels data bank program is designed to provide a source of current technical information concerning the utilization of alternate fuels for vehicle/transport applications. The primary input to this system comes from both published research and progress reports from ongoing research and development activities.

45098 (CONF-7805102—(Summ.), pp 587-599) **Engine and environment improvement possibilities with alcohols.** Pefley, R. (Santa Clara Univ., CA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

Previous work on this project involved the characterization of a 2300 cc Pinto engine on Indolene. The carburetor and intake maniford heating were then modified for operation on straight alcohol fuels. The engine was recharacterized on methanol. Alternate fuel systems to deal with maldistribution were also examined. The conclusions arrived at from this prior work were: maldistribution impairs accurate assessment of methanol improvement potential; power, efficiency, and emissions (particularly NOx) for the same C.R. and equivalence ratio are equaled or improved when methanol is substituted for gasoline; and aldehyde emissions are somewhat higher for methanol. The scope of the project presently underway encompasses: evaluation of methods for improving engine performance on methanol through dynamometer testing and computer simulation; equipment of a ten-car fleet with selected hardware for evaluation in urban and highway test procedures and in road performance; and continuation of the comparative study of environmental consequences resulting from the use of gasoline and methanol via smog chamber and biological investigations. The schedule for these activities and results so far obtained are presented.

45099 (CONF-7805102—(Summ.), pp 600-609) **Engine lubricants for use in alcohol fueled highway vehicles.** Owens, E. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

A three-phase program to study engine lubricants for use in alcohol-fueled highway vehicles is discussed. The program objectives are to assess the effects of methanol fuels on engine lubrication and wear, determine materials and conditions implicated in increased wear and corrosion, and develop lubricant formulations suitable for use with methanol-containing fuels. The test results, at sufficiently

low operating temperatures, showed the following: methanol increases piston ring wear and corrosion attack is implicated in this wear increase, methanol increases wear of copper-containing bearings, and some lubricants form emulsions which can retain large concentrations of methanol and water. (RCK)

45100 (CONF-7805102—(Summ.), pp 609-620) **Engine modifications for use of methanol and methanol-gasoline blends.** Patterson, D.J. (Univ. of Michigan, Ann Arbor). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The engine modifications required to obtain the optimum performance of automobiles fueled with heat methanol or with methanol—alcohol blends were studied by reviewing published literature and by in-depth survey interviews. From these sources, it was concluded that there are no insoluable technical barriers to using methanol or methanol—gasoline blends in spark ignition engines, although existing vehicles would require considerable retrofitting to obtain optimum performance with these fuels. New engines could be built for satisfactory operation on these fuels using existing technology. Pure methanol is preferred to methanol blends as an alternative fuel. Future alcohol fuels will require controlled blending with hydrocarbon constituents in order to control front-end volatility and asure good cold starting and hot fuel handling properties. (LCL)

45101 (CONF-7805102—(Summ.), pp 620-627) **Solving alcohol fuel problems by fuel modification.** Keller, J.L. (Union Oil Co. of California, Los Angeles). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

This project had three objectives related to the use of methanol as fuel for highway vehicles. These were to identify and characterize problems with methanol fuels, evaluate fuel modification solutions, and to recommend areas for further study. Thirty-six potential problems were identified within six broad areas. Twenty-two of these problems were selected for further study to evaluate possible solutions. Specific recommendations for further study and testing of methanol fuels are presented. (RCK)

45102 (CONF-7805102—(Summ.), pp 627-635) **Etherified fuels: transitional approach to straight oxygenated hydrocarbons?.** Talbot, A. Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objective of this study was to evaluate the use of ether fuels, produced from coal, as full or partial replacement for petroleum-derived transportation fuels. The establishment of the economics of manufacturing ether fuels, starting from coal, and the utilization of these fuels as substitutes for transportation fuels derived from petroleum are discussed. It is concluded that ether has the potential to be a high quality fuel component but that the economics are at this point undefined and bear investigation as well as performance in vehicles. (RCK)

45103 (CONF-7805102—(Summ.), pp 635-649) **Passenger car fuel economy in short trip operation.** Phoebe, C.H. (Gulf Research and Development Co., Pittsburgh, PA). Sep 1978.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The objective of this study was to assess the benefit that could be obtained from a gasoline blended to provide improved short trip fuel economy. The approach used was to develop a test procedure to effectively evaluate any method that shows promise for improved fuel utilization, and to use the procedure to obtain a better understanding of what is needed in present day gasoline to improve short trip economy. A factorial test design was used to compare typical seasonal fuels with a special fuel developed to better establish the effect of fuel gravity on fuel economy. Based on test results it was concluded that: whenever it was possible to detect a significant difference between fuels, the special fuel developed for this program gave improved fuel economy; the fuels used in this program were within the range of typical fuels and could not be used to establish a true minimum baseline; levels of significance of 99% or more obtained in the analysis of variance, support the accuracy of the measurements attained with the test equipment; and some cars are much more fuel efficient in short trip operation than others; a procedure of this type can spotlight the cars that use excessive amounts of fuel. (RCK)

MATERIALS

45104 (UCRL—50028-79-1) **H-division quarterly report, January—March 1979.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 May 1979. Contract W-7405-ENG-48. 51p. Dep. NTIS, PC A04/MF A01.

This report defines the objectives of the groups in H Division of the LLL Physics Department and describes the status of projects under way: Theoretical EOS Group - status of the LLL tabular EOS library, high-pressure melting transition in quartz, study of polyatomic systems, H_2—H_2 potentials, constitutive model for plastic deformation in preheated materials, melting of diamond; Experimental Physics Group - improved diagnostic capabilities for laser-driven shock-wave experiments, properties of materials at high pressure, reflected shock design, electrical resistivity and the melting transition in copper; Fluid Physics Group - perturbation theory calculations of thermodynamic properties of liquid metals and dense plasmas, shock-wave structure in dense fluids; Code Development/Applied Physics Group - dynamic loading of the structural wall in a lithium fall fusion reactor, study of armor penetration by shaped charge jets, computation of the Cabriolet event, fluid—structure coupling for the PELE-IC code. Detailed individual reports on completed work may be expected. 33 figures, 5 tables. (RWR)

45105 (UCRL—82268) **Standards for the publication of powder patterns: the American Crystallographic Association subcommittee's final report.** Calvert, L.D.; Flippen-Anderson, J.L.; Hubbard, C.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1979. Contract W-7405-ENG-48. 45p. (CONF-790637—1). Dep. NTIS, PC A03/MF A01.

From Symposium on accuracy in power diffraction; Washington, DC, USA (11 Jun 1979).

Portions of this document are illegible.

A subcommittee of the American Crystallographic Association (ACA) was formed to recommend some guidelines that would improve the overall quality of published powder diffraction data. An analysis of the Powder Diffraction File shows that many of the well-known techniques for obtaining good quality data are often not being applied, and hence there is a need for the establishment of publication standards. A major recommendation from this subcommittee is the use of a standard data-form at the author/referee level of publication. The proposed data-form is divided into five sections: sample characterization, technique, unit cell data, references, and the powder data. The information asked for in these five sections represents what, in most cases, the referee and editor can reasonably expect of experimenters seeking to publish their powder data. An example of a filled-out form is shown, and instructions for completing the form are given. Another recommendation is that the ACA request that the International Union of Crystallography consider implementing these recommendations in all IUCr journals.

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 44770, 45118, 45140, 45141

45106 (BDX—613-2229(Rev.)) **Plasma cleaning end-of-process detection.** Smith, M.D. (Bendix Corp., Kansas City, MO (USA)). 1979. Contract EY-76-C-04-0613. 14p. (CONF-790668—1). Dep. NTIS, PC A02/MF A01.

From DOE weapons complex annual adhesives conference; Amarillo, TX, USA (5 Jun 1979).

Activated gas plasma is being used extensively to remove trace organic contamination from electromechanical components prior to final assembly. Optical emission techniques are being used throughout the electronics industry to determine end-points of plasma processes for removing large amounts of photo-resist. The application of these techniques to detect the removal of trace organic residues was shown to be possible using a vendor's process monitor. Removal of as low as 5 mg total organic contamination was detected in an oxygen plasma. Auger analysis confirmed the cleanliness levels indicated by the end-point detector tested. The simplicity of this type of process monitor lends itself to production line use for the plasma cleaning of various parts and batch sizes. The monitoring of argon plasma cleaning processes using optical emission techniques has also been investigated.

45107 (CONF-761168—(Summ.)) **Thin film problems and research in energy systems.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Jan 1979. 159p. Dep. NTIS, PC A08/MF A01.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Individual presentations and recommendations for future efforts in thin film research for energy related applications are presented. A workshop was held (November 1 to 4, 1976 at Asilomar State Beach, Pacific Grove, California), and the report serves as a summary of that meeting. The workshop had three phases: the first phase presented the long term thin film coating needs of three programs whose purpose is to develop national energy sources; the second phase consisted of presentations of the current state of knowledge in a broad range of thin film related science; the final phase was a summary session to prepare recommendations for future research areas.

45108 (CONF-761168—(Summ.), pp 106-114) **Scale-up considerations in optical thin films.** Seddon, R.I. (Optical Coating Lab., Inc., Santa Rosa, CA). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Vacuum evaporation, transition from batch to continuous processing including cost and support, scale-up from small to large batch operation including repeatability and uniformity, and sputtering system are discussed. (FS)

45109 (SAND—79-0890C) **Effects of metallurgical microstructure of armatures on compressed magnetic field generators.** Binder, A.E.; Nordstrom, T.V. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 27p. (CONF-790540—3). Dep. NTIS, PC A03/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

Methods for improving uniform expansion behavior of compressed magnetic field device armatures were studied. Initial microstructure of the copper tubes was altered in a controlled manner by using different forming techniques and alloying. Results show a 25 to 50% improvement in uniform explosive expansion radius for electroformed and spun copper armatures compared to standard armatures machined from drawn tubing. Expansion improvement has been correlated with changes in the mechanical texture due to forming. The smoother expansion, however, did not result in a significantly higher electrical efficiency with the armature parameters tested.

45110 **Method of controlling defect orientation in silicon crystal ribbon growth.** Leipold, M.H. US Patent 4,121,965. 24 Oct 1978. Filed date 16 Jul 1976. 4p.

The orientation of twinning and other effects in silicon crystal ribbon growth is controlled by use of a starting seed crystal having a specific (110) crystallographic plane and (112) crystallographic growth direction.

STRUCTURE AND PHASE STUDIES

45111 (BNL—26191) **Determination of the vacancy formation enthalpy for high purity Ni.** Lynn, K.G.; Snead, C.L. Jr.; Hurst, J.J.; Farrell, K. (Brookhaven National Lab., Upton, NY (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-790437—11). Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Positron-annihilation lifetime measurements have been made on Ni over a temperature range of 4.2 to 1700 K. We find a small change in the lifetime from 4.2 to 900 K indicating a very small thermal-expansion effect. A small precursor effect is observed before the onset of significant vacancy trapping. A monovacancy formation enthalpy of 1.54/sub +0.2//sup -0.1/ eV is extracted without taking divacancies into consideration in the analysis. No detrapping from mono-vacancies is observed even at the higher temperatures. The vacancy formation enthalpy extracted from the lifetime data is compared to values obtained by Doppler-broadening and angular-correlation techniques.

45112 (LBL—9264) **Computer simulation of martensitic transformations in idealized systems.** Chen, S.H.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 172p. Dep. NTIS, PC A08/MF A01.

Thesis.

Very little theoretical work on the development of the martensitic transformation and the characteristics of the resulting microstructure exists. This thesis advances the theory of the martensite transformation by constructing a computer model of a martensitic transformation in an idealized system. The model has its source in the general observation that the characteristics of martensitic transformations in solids are largely determined by accomodating the strain associated with the martensitic distortion of the crystal lattice. A review and adaptation of prior theoretical work leads to the development of a theory which allows the straightforward computation of the elastic energy associated with an arbitrary distribution of defects in an elastically anisotropic body under the assumption that the body has uniform elastic constants and that anharmonic effects may be neglected. Equations are cast in which the energy is written as a simple sum of binary interactions in which the defects influence one another according to an elastic potential whose form can be calculated. At the time that the energetic equations take a simple form the kinematics of the process involving the appearance of elastic inclusions are also known to be simple. The martiensitic transformation is modeled as a transformation which occurs through the sequential formation of individual martensitic elements, each carries the elementary transformation strain. Statistical equations developed govern the selection of the transformation path, or sequence that elementary martensite particles appear in the model, and specifies the kinetics of transformation.A useful representative path is defined as the minimum energy path. The model is used for the detailed simulation of a martensitic transformation in a pseudo two-dimensional system. Virtually all interesting qualitative aspects of the developing martensitic transformation are shown to be inherently present within it.

45113 **Electrical resistivity studies of order—disorder phenomena in V_2H and V_2D.** Bambakidis, G. (Wright State Univ., Dayton, OH); Pershing, M.W.; Bowman, R.C. Jr. *Scr. Metall.;* **13**: No. 6, 441-446(Jun 1979).

Vanadium hydride and deuteride samples were prepared by absorption of H and D into foils of Marz-grade V metal. Electrical resistivity measurements were made in the temperature range of -185 to 200°C. Phase transitions were studied. (FS)

45114 **Diffusional mass transport in polycrystals containing stationary or migrating grain boundaries.** Cahn, J.W. (National Bureau of Standards, Washington, DC); Balluffi, R.W. *Scr. Metall.;* **13**: No. 6, 499-502(Jun 1979).

The regimes of diffusional transport behavior which may exist in a polycrystalline material taking into account the possibility that the grain boundaries may be stationary or migrating are classified. (FS)

45115 **Diffusion induced grain boundary migration.** Cahn, J.W. (National Bureau of Standards, Washington, DC); Pan, J.D.; Balluffi, R.W. *Scr. Metall.;* **13**: No. 6, 503-509(Jun 1979).

Evidence of grain and interphase boundaries providing high diffusivity paths in solids is reviewed. (FS)

45116 **Comment on the paper "EXAFS measurements on Nb_3Ge thin films" by G.S. Brown et al.** Pande, C.S.; Viswanathan, R. (Brookhaven National Lab., Upton, NY). *Solid State Commun.;* **26**: 893-895(1978).

It has been reported recently that Nb_3Ge specimens showing superconducting transition temperatures less than the maximum possible value contain a quasi-amorphous phase. The possibility that the lower values of T/sub c/ of these specimens may be accounted for by the proximity effect due to these quasi-amorphous regions is discussed.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 45738

45117 (BDX—613-2170(Rev.)) **Chemistry and heat-treatment effects on mechanical and microstructural properties of heat-treated, beta-extruded Ti—6A1—6V—2Sn.** Ulitchny, M.G.; Rack, H.J.; Dawson, D.B. (Sandia Labs., Livermore, CA (USA); Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0613. 50p. Dep. NTIS, PC A03/MF A01.

The mechanical behavior of beta-extruded Ti—6A1—6V—2Sn was examined after a variety of sub-transus heat treatments. The microstructural variations resulting from the range of heat treatments studied also were examined. A range of alloy chemistries, within commercial limits, was used to evaluate the effect of this variable on mechanical properties. The strength—toughness combinations obtained in beta-extruded Ti—6A1—6V—2Sn ranged from about 895 MPa and 82.5 MPa$\sqrt{m}$ for duplex annealed material to 1200 MPa and 54.9 MPa$\sqrt{m}$ for solution treated and peak aged material. Chemistry variations had less effect on mechanical properties than would have been the case with alpha—beta processing.

45118 (CONF-761168—(Summ.), pp 76-78) **Application of composition modulated thin films.** Hilliard, J.E. (Northwestern Univ., Evanston, IL). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Film produced by evaporating two components through a rotating pinwheel shutter which cuts off the vapor first from one source and then the other are evaluated. These films have a modulated composition rather than a layered structure. Mechanical properties were determined using a bulge tester. (FS)

45119 (COO—3459-15) **Delayed failure of vanadium—hydrogen alloys.** Chung, D.W.; Stoloff, N.S. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 1979. Contract EY-76-S-02-3459. 10p. (CONF-790820—2). Dep. NTIS, PC A02/MF A01.

From 3. international conference on mechanical behaviour of materials; Cambridge, UK (20 Aug 1979).

Delayed failure experiments on vanadium and several hydrogenated alloys resulted in two distinct patterns of behavior: ordinary stress-rupture behavior (non-embrittlement) in annealed vanadium and alloys with hydrogen in solution, and high susceptibility to delayed failure (embrittlement) in the hydrided alloys. Reorientation of hydrides under stress has been observed. Hydrogen in solution in vanadium did not play a major role in initiating delayed failure, although rupture stresses were lowered due to the enhancement of the local stress concentration factor by increasing flow stress. Hydrides did not crack at notch roots, suggesting that they produced an indirect effect on fracture behavior by increasing matrix yield stress, thereby reducing the blunting influence of the plastic zone at a crack tip.

45120 **Effects of waveshape on crack initiation in low-cycle fatigue.** Maiya, P.S.; Majumdar, S. (Argonne National Lab., IL). *Scr. Metall.;* **13**: No. 6, 485-490(Jun 1979).

Waveshape influence on fatigue - fr crack initiation life is discussed. The effect of a compressive hold is mainly on crack initiation life, while a decrease of strain rate seems to reduce both the crack-initiation and the crack-propagation life. (FS)

45121 **Correlation of positron lifetime and hardness stuides of the deformation of 4340 steel.** Alex, F.; Byrne, J.G. (Univ. of Utah, Salt Lake City). *Mater. Res. Bull.;* **14**: No. 6, 821-824(Jun 1979).

Positron lifetime and TEM measurements were earlier used to study changes in A1S1 4340 steel due to variations in heat treatment, degree of cold work and subsequent hydrogen charging. The current results correlate trends in microhardness and superficial hardness with the earlier results in a region within 6 x 10^{-6}m of the surface. Strain softening, noted in this surface region during tensile straining, correlates with TEM and positron annihilation findings.

45122 **Effect of an electric current on the relaxation of stresses in crystals of zinc, cadmium, and lead.** Troitskii, O.A.; Spitsyn, A.V.I.; Stashenko, V.I. (Institute of Physical Chemistry, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 7, 509-511(Jul 1978).

The use of pulsed currents allowed straight forward determination of the plastic deformation of Zn, Cd, and Pb. (AIP)

45123 **Analysis of thermal fatigue crack growth in 2.25% Cr 1% Mo steel superheater tubes caused by on-load water deslagging.** Newton, J.D.; Melksham, M.H. (State Electricity Commission of Victoria, Richmond). pp 369-386 of Ash deposits and corrosion due to impurities in combustion gases. Bryers, R.W. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From Conference on ash deposits and corrosion due to impurities in combustion gases; Henniker, NH, USA (26 Jun 1977).

On-load water deslagging is an effective method of cleaning boiler heat transfer surfaces, but an attendant problem is the initiation and growth of thermal fatigue cracks. The growth of the cracks has been analyzed and shown to be governed by the same basic relationship as that which holds for mechanical fatigue cracks. Fundamental to any analysis of fatigue crack growth is a knowledge of the alternating stress intensity. This was obtained by first determining, from a finite element stress analysis, the thermal shock stress, caused by on-load deslagging, and then calculating the stress intensity factor, using relationships available in the literature, and making a critical correction for the presence of multiple cracks.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 44555, 45113, 45135, 45213, 45531

45124 (CONF-790341—8) **Transport properties of the compositionally modulated alloy Cu/Ni.** Schuller, I.; Falco, C.M.; Hilliard, J.; Ketterson, J.; Thaler, B.; Lacoe, R.; Dee, R. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA); California Univ., Los Angeles (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

Preliminary transport measurements, electrical resistivity, thermopower, Hall effect and magnetoresistance, of a number of Cu/Ni composition modulated alloy films over the temperature range 10 to 300°K and for magnetic field up to 70 kGauss are reported. The results indicate non-monotonic dependence of the transport properties on the modulation amplitude. The Hall coefficient saturates around 40 kGauss in contrast to the transverse magnetoresistance which does not show evidence for saturation up to 70 kGauss.

45125 **Self-consistent electronic structure of chemisorption bonding: c (2 x 2) O on Ni(001).** Wang, C.S.; Freeman, A.J. (Materials Research Center and Physics Department, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., B: Condens. Matter;* **19**: No. 10, 4930-4934(15 May 1979).

The validity of local-density theory for describing chemisorption bonding on a reactive-transition-metal surface is studied by means of self-consistent band calculations for c (2 x 2) O on Ni(001). We find O 2p bonding states 2 eV wide (and split by 1 eV) lying 5.5 eV below and the antibonding states just above the Fermi level in very good agreement with available spectroscopic data.

45126 **Electron-lifetime anisotropy in magnesium.** Brown, R.L.; Friedberg, C.B. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). *Phys. Rev., B: Condens. Matter;* **19**: No. 10, 5123-5130(15 May 1979).

De Haas—van Alphen measurements have been performed to study electron lifetimes in ultrapure magnesium and in very dilute magnesium alloys. For selected orbits the observed Dingle temperatures (T/sub D/) were found to be independent of magnetic field direction for fields in the basal plane, whereas in the (1010) plane a strong anisotropy was observed. In pure magnesium T/sub D/ decreased by a factor of 5 as the field was rotated from the <1120> axis towards <0001>, reaching a minimum value of less than 0.08 K, which corresponds to an electron lifetime of at least 1.5 x 10^{-11} sec for these orbits. The lifetime anisotropy is attributed to dislocation scattering in these crystals for which the dislocation density was characterized experimentally and found to be in the range of 10^{3}—10^{5} cm^{-2}. The results are compared with previous de Haas—van Alphen studies of dislocations, as well as previous lifetime measurements obtained by the electron-interference technique. An analysis in terms of the dephasing theory due to Watts is presented, and it is suggested that the presence of dislocation multipole arrays is important.

45127 **Some experiments on powdered $PrNi_5$ in contact with liquid ^{3}He.** Roach, P.R.; Webb, R.A.; Ketterson, J.B. (Argonne National Laboratory, Argonne, Illinois). *J. Low Temp. Phys.;* **34**: No. 3, 439-444(1 Feb 1979).

We report on two sets of measurements on powdered $PrNi_5$ in contact with liquid ^{3}He: low-temperature magnetic susceptibility using SQUID magnetometer techniques, and also thermal relaxation and heat capacity measurements. In addition, a demagnetization experiment using the hyperfine enhanced nuclear cooling capability of $PrNi_5$ to cool liquid ^{3}He to 1.1 mK is described.

45128 **Fine structure of the current-voltage characteristics of Nb—I—Pb junctions.** Belous, N.A.; Lezhnenko, I.V.; Pan, V.M.; Rudenko, E.M. (Institute of Metal Physics, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **4**: No. 11, 699-700(Nov 1978).

The current-voltage characteristics and differential resistance dU/dI of Nb—I—Pb tunnel junctions are investigated. It is shown that in the barrier layer of the niobium film, besides regions of reduced critical temperature, there are regions in which superconductivity is completely suppressed. The barrier layer is inhomogeneous in thickness. A singularity is observed on the dU/dI curves at Δ/sub Pb/.

45129 **Effect of the superconducting transition on phonon energies and lifetimes in lead.** Youngblood, R.; Noda, Y.; Shirane, G. (Brookhaven National Lab., Upton, NY (USA)). *Solid State Commun.;* **27**: No. 12, 1433-1435(Sep 1978).

A high-resolution inelastic neutron scattering study has been made of certain transverse phonons in lead. It is found that neither the energies nor the linewidths change appreciably with the onset of superconductivity. This finding contradicts a recent experimental report, but is in accord with theoretical expectations.

45130 **Thermodynamics of liquid Ca-Ag and Ca-In alloys.** Delcet, J.; Egan, J.J. (Brookhaven National Lab., Upton, NY (USA)). *J. Less-Common Met.;* **59**: No. 2, 229-236(Jun 1978).

Free energies of mixing have been determined for the liquid binary alloys Ca-Ag and Ca-In at 800°C using an e.m.f. technique employing CaF_2 as a solid electrolyte. Although partial electronic conduction exists under certain conditions in CaF_2, it was still found useful as an electrolyte to obtain thermodynamic data. Appropriate equations are presented. The entropy of mixing of Ca-In alloys is also given.

45131 **Magnetic properties and spin-reorientation phase transitions in intermetallic compounds Nd/sub 1-x/U/sub x/Co_5.** Deryagin, A.V.; Andreev, A.V.; Reimer, V.A. (Urals State University). *Sov. Phys. - JETP (Engl. Transl.);* **47**: No. 5, 933-937(May 1978).

The crystal structure of powders and the magnetic moments and magnetocrystalline anisotropy of single crystals, as functions of

the uranium concentration and the temperature, have been investigated for the compounds Nd/sub 1-x/U/sub x/Co_5. For comparison, the results of similar investigations are presented for Y/sub 1-x/U/sub x/Co_5. In the compounds studied, the uranium is apparently nonmagnetic and gives up all electrons from its 5f, 6d, and 7s electronic shells to the 3d band of the cobalt, thereby decreasing the value of its mean magnetic moment. By variation of the uranium concentration, it is possible to vary substantially the temperature range of spin-reorientation magnetic phase transitions.

45132 Negative magnetoresistance in glassy carbon. Saxena, R.R.; Bragg, R.H. (Univ. of California, Berkeley). *Philos. Mag.;* **36**: No. 6, 1445-1456(1977).

An extensive experimental investigation of the negative magnetoresistance phenomenon in a non-crystalline carbon has been carried out. The microstructure of the material was altered by heat treating in the range 1000° to 2800°C, and the effect of the changes induced was measured as a function of temperature (10 to 300°K) and magnetic field (0 to 50 kG). The negative magnetoresistance was found to follow a f(H/T/sup 1/2/) dependence over a large range of temperatures and magnetic fields. The mechanism is thought to be spin—flip scattering from localized spins. Starting with Δ rho varies as -m^2, where m is the magnetic moment per localized spin, the discussion relates the observed negative magnetoresistance to the anomalous behavior of the spin susceptibility on the metallic side of the metal-insulator transition.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 44221, 44271, 44284, 44286, 44287, 44288, 44332, 44333, 44450, 44462

45133 (FE—1743-62, pp 47-55) **Zinc chloride oxychlorination corrosion studies of various metals, alloys, and inorganics.** Wolfe, L.H.; Radd, F.J.; Creech, H.E. 20 Nov 1978.

In Zinc halide hydrocracking process for distillate fuels from coal.

Zinc Chloride - HCl—O_2 corrosion attacks upon 19 alloys, 7 ceramics, and 4 pure metals at 732°C and 1 atmosphere were surveyed by weight loss an metallographic methods. A few resistant alloys were defined. All the ceramics tested were resistant, except that vycor (SiO_2) formed Zn_2SiO_4 slowly.

45134 (PUB—304) **Erosion/corrosion newsletter.** Levy, A.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Research in corrosion/erosion is reported including steep angle impingement corrosion, particle trajectory analysis of gas-solid particle mixtures in a curved duct, plasticity in corrosion of ductile metals, erosion behavior of oxide scales, corrosion of SS-310, effect of water vapor and crystal orientation on the performance of a sulfur probe based on CaF_2 electrolyte, solid state probe for SO_2/SO_3 based on Na_2SO_4I electrolyte, and corrosion of alloys in oil shale retorting. (FS)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 44776, 45756

45135 (AD-A—059643) **Studies of magnetic flux and critical current distributions near the surface in type II superconductors. Final report.** Rollins, R.W. (Ohio Univ., Athens (USA). Dept. of Physics). Aug 1978. 47p. NTIS PC A03/MF A01.

Very pure annealed Nb samples were irradiated with 3.2 and 5 MeV protons to fluences of about 6.8 x $10_{(16)}$ p/$cm_{(2)}$. Local magnetic induction profiles, when the samples were in the superconducting mixed state, were obtained using an ac technique. Electron micrographs of the same irradiated samples show dislocation loops in the damaged region of the samples. The critical current and the volume flux pinning force were determined from the slope of the measured field profiles. If pinning is due to the observed dislocation loops, the pinning force calculated from a direct summation law is an order of magnitude higher than the experimental result and as calculated from quadratic summation laws is two to three orders of magnitude smaller than measured.

45136 (CONF-790657—2) **Effect of phase instabilities on the correlation of nickel ion and neutron irradiation swelling in solution annealed 316 stainless steel.** Rowcliffe, A.F.; Lee, E.H.; Sklad, P.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From Conference on irradiation behavior of metallic materials for fast reactor core components; Corsica, France (5 Jun 1979).

Annealed 316 stainless steel specimens were neutron irradiated to establish steady-state microstructures and then subjected to further high temperature irradiations with 4 MeV Ni ions. It is shown that void growth under neutron irradiation is simulated in ion irradiations carried out at ~ 180°C above reactor temperature. However, the precipitate microstructure developed during neutron irradiation is unstable during subsequent ion irradiation. As a result, the relative swelling rates at various reactor temperatures are not simulated correctly.

45137 Radiation-induced polymorphism in Ag—He solid solutions. Palatnik, L.S.; Koz'ma, A.A.; Fuks, M.Y.; Fogel', Y.M.; Tishchenko, L.P. (V. I. Lenin Khar'kov Polytechnic Institute). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 9, 628-630(Sep 1978).

Silver films with a thickness of 900—1200 A were bombarded with 10 KeV He^+ ions at doses of 5.10^{14}-4.10^{16} ions/cm^2. The lattice constant and residual resistance were studied. (AIP)

45138 Influence of a plasma on the interaction of laser radiation with a metal. Zhiryakov, B.M.; Popov, N.I.; Samokhin, A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - JETP (Engl. Transl.);* **48**: No. 2, 247-252(Aug 1978).

An investigation was made of the behavior of a plasma jet and recoil pressure during the action of quasicontinuous millisecond pulses from a neodymium laser on the surface of lead in air. Instability of the laser-beam maintenance of a plasma in the stream of the evaporated target materials was observed near the radiation intensity $I_{кр}$2 MW/cm^2. The plasma appearance threshold was less than the intensity needed to maintain it continuously. The plasma jet instability was manifested by periodic detachment of the jet from the target surface and accompanied by oscillations of the recoil pressure p (t). Characteristics of the behavior of p (t) indicated that the effective optical thickness of the jet was $\sigma <$ or ≈ 1.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 45045

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 45202

45139 (CONF-790442—13) **Development of tungsten coatings for the corrosion protection of alumina-based ceramics.** Arons, R.M.; Dusek, J.T.; Hafstrom, J.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

A means of applying tungsten coatings to an alumina based ceramic is described. A slurry of pure tungsten was prepared and applied by brush coating or slip casting on the alumina-3 wt % Yt small crucible. The composite was fired and a very dense ceramic crucible with a crack free tungsten coating was produced. (FS)

45140 (GEPP-OP—402) **Effects of vacuum processing erbium dideuteride/ditritide films deposited on chromium underlays on copper substrates.** Provo, J.L. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1978. Contract EY-76-C-04-0656. 15p. (CONF-781130—13). Dep. NTIS, PC A02/MF A01.

From 25. national vacuum symposium; San Francisco, CA, USA (27 Nov 1978).

Thin films of erbium dideuteride/ditritide were experimentally produced on chromium underlays deposited on copper substrates. The chromium underlay is required to prevent erbium occluder/copper substrate alloying which inhibits hydriding. Data taken has shown that vacuum processing affects the erbium/chromium/copper interaction. With an in situ process in which underlay/occluder films are vacuum deposited onto copper substrates and hydrided with no air exposure between these steps, data indicates a minimum of 1500A of chromium is required for optimum hydriding. If films are vacuum deposited as above and air-exposed before hydriding, a minimum of 3000A of chromium was shown to be required for equivalent hydriding. Data suggests that the activation step (600°C for 1 hour) required for hydriding the film of the second type is responsible for the difference observed. Such underlay thickness parameters are important, with regard to heat transfer considerations in thin hydride targets used for neutron generation.

45141 (Y/DA—8225) **Application of metal oxide refractories for melting and casting reactive metals.** Jessen, N.C. Jr.; Holcombe, C.E. Jr.; Townsend, A.B. (Oak Ridge Y-12 Plant, TN (USA)). 25 May 1979. Contract W-7405-ENG-26. 22p. (CONF-790442—16). Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

Extensive investigations have been conducted to develop metal oxide refractories for containment of molten uranium and

uranium alloys. Since uranium and uranium alloys are readily susceptable to the formation of complex oxides, carbides, nitrides, intermetallic compounds, and suboxide reactions, severe problems exist for the production of quality castings. These contamination reactions are dependent on temperature, pressure, and molten metal interfacial reactions. The need for high purity metals to meet specification repeatedly has resulted in the development of improved metal oxide refractories and sophisticated furnace controls. Applications of Y_2O_3 for use as a crucible and mold coating, precision molds and cores, and high temperature castable ceramics are discussed. Experimental results on melt impurity levels, thermal controls during melting, surface interactions and casting quality are presented.

45142 Glass-ceramic composition for hermetic seals. Ballard, C.P. Jr. (to Dept. of Energy). US Patent 4,135,936. 23 Jan 1979. Filed date 16 Jun 1978. 4p.

PAT-APPL-916,398.

The invention relates to a glass-ceramic composition having a high fracture strength adaptable for hermetically sealing to chromium bearing iron or nickel base alloys at temperatures of between about 950°C to about 1100°C to form a hermetically sealed insulator body, comprising from about 55 to about 65 weight percent SiO_2, from about 0 to about 5 weight percent Al_2O_3, from about 6 to about 11 weight % Li_2O, from about 25 to about 32 weight percent BaO, from about 0.5 to about 1.0 weight percent CoO and from about 1.5 to about 3.5 weight percent P_2O_5.

STRUCTURE AND PHASE STUDIES

45143 (BNL—26075) Neutron spectroscopy of fast hydrogen diffusion in BCC transition metals. Richter, D. (Brookhaven National Lab., Upton, NY); Lottner, V. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 17p. (CONF-790538—1). Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

Quasielastic neutron scattering reveals microscopic details of both the time and space development of the H-diffusion process on an atomic scale. After outlining the method on the example of PdH/sub x/, new results on the jump geometry in bcc metals are surveyed. In particular, the anomalous diffusion behavior of H in Nb, Ta, and V at elevated temperature is emphasized, where correlated jump processes are important. The influence of impurities on the H-diffusion process is demonstrated by experiments performed on NbH/sub x/ doped with nitrogen impurities, which act as trapping centers for the diffusing hydrogen. The results are discussed in terms of a two-state random walk model which includes multiple trapping and detrapping processes. The concentration and temperature dependence of the capture and escape rates of traps are obtained.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 45119

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 44485

45144 Electronic structure of metal hydrides. I. Optical studies of ScH_2, YH_2, and LuH_2. Weaver, J.H.; Rosei, R.; Peterson, D.T. (Synchrotron Radiation Center, University of Wisconsin-Madison, Stoughton, Wisconsin 53589). *Phys. Rev., B: Condens. Matter;* **19**: No. 10, 4855-4866(15 May 1979).

We have examined the electronic structure of ScH_2, YH_2, and LuH_2 using optical absorptivity and thermoreflectance techniques in the photon energy range from 0.2 to 5 eV between 4.2 and 340 K. The measured quantities were used to determine the frequency-dependent dielectric functions and the dependence of the dielectric functions on temperature modulation. The results show that the low-energy properties ($h\nu <$ or $\approx$ 1.5 eV) are dominated by intraband absorption and a plasmon falling near 1.5—1.8 eV. Interband absorption is observed to be strong and structured above the interband onsets of ~ 1.25, ~ 1.6, and ~ 1.9 eV for ScH_2, YH_2, and LuH_2, respectively. The observed interband features can be interpreted in terms of the self-consistent band calculations of ScH_2 and YH_2 presented in the companion paper, and experimental features can be related to specific bands in particular parts of the Brillouin zone. The systematics observed in these three trivalent metal dihydrides can be correlated well to theory. Extensive studies with samples of varying hydrogen to metal ratio (x) within the dihydride phase were carried out to examine the influence of hydrogen sublattice disorder on the optical properties and electronic structure. It was observed that, for x approaching 2, interband features which could be related to d-band absorption were broadened by increasing

45145 Electronic structure of metal hydrides. II. Band theory of ScH_2 and YH_2. Peterman, D.D.; Harmon, B.N.; Marchiando, J.; Weaver, J.H. (Ames Laboratory United States Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., B: Condens. Matter;* **19**: No. 10, 4867-4875(15 May 1979).

Self-consistent band-structure calculations have been performed for ScH_2 and YH_2 using the Korringa-Kohn-Rostoker method. The results indicate a net charge transfer from the metal to the hydrogen site and a concomitant raising of the hydrogen bonding bands relative to those obtained through non-self-consistent calculations. Comparisons are made between the results of our calculations and the results of optical studies by Weaver, Rosei, and Peterson. Additional calculations were performed in which the Fermi level or band gaps were rigidly shifted by a small energy increment. These calculations were used to simulate the derivative structure obtained in thermomodulation spectra and helped to identify the k-space origin of several experimental interband features found in the thermoreflectance of ScH_2 and YH_2. The experimentally observed, low energy, stoichiometry-dependent optical features of YH_2, which had partially inspired our studies, were not interpretable within the framework of our calculations based on the CaF_2 structure in which the hydrogen occupies all of the available tetrahedral sites. Instead, indirect evidence suggests that these low-energy features are associated with partial occupation of octahedral sites.

45146 Fundamental defect centers in glass: The peroxy radical in irradiated, high-purity, fused silica. Friebele, E.J.; Griscom, D.L.; Stapelbroek, M.; Weeks, R.A. (Naval Research Laboratory, Washington, D. C. 20375). *Phys. Rev. Lett.;* **42**: No. 20, 1346-1349(14 May 1979).

A new fundamental radiation-induced defect in high-purity synthetic silica has been identified by electron-spin—resonance studies of ^{17}O-enriched SiO_2 as a peroxy radical O_3^- bonded to one Si in the glass matrix. The precursors of these defects are envisioned to be ---Si—O—O—Si--- structures, some of which preexist in the silica, are formed in greater numbers during neutron bombardment, and which may release an electron either during irradiation or subsequent annealing.

45147 Acceptor properties of sulfur in the semiconducting compounds CeO_2 and TiO_2. Arkharov, A.V.I.; Suntsov, N.V.; Miloslavskii, A.G. (Academy of Sciences of the Ukrainian SSR, Donetsk State University). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 8, 600-601(Aug 1978).

The electric conductivity of TiO_2 and CeO_2 was studied experimentally and theoretically for the temperature range 1173—1473° K. The results of 5 doping are considered in terms of the concentration of free electrons. (AIP)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 45134

RADIATION EFFECTS

45148 Effect of ion bombardment on the metal—dielectric phase transition in vanadium dioxide. Suvorov, A.V.; Terukov, E.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 537(Nov 1978).

VO_2 films were bombarded with 50—100 keV B^+ ions leading to a color change and the "latent-image" effect.(AIP)

COMPOSITE MATERIALS

REFER ALSO TO CITATION(S) 45152

PREPARATION AND FABRICATION

45149 (UCRL—52434(Vol.5)) Development of alternate silicone potting compounds. Vol. 5. Development of substitute No. 1 for Dow Corning's aerospace sealant DC93-122. Cady, W.E.; Buckner, A.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Feb 1979. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

A substitute for Dow Corning DC93-122 silicone potting resin can be formulated from Sylgard 186, accelerator QCF3-6559, DC1107 fluid, and Cabosil Grade MS-75 SiO_2. The substitute is a functional replacement that is fast-setting and nonflowing, but is stronger and harder than the material it replaces. Two lots of Sylgard 186 were evaluated and it was found that the variations in the cure rate of the 186 affect the amounts of accelerator and 1107 required to achieve a fast setup. The variation in the viscosity of the 186 affects the amount of SiO_2 required to achieve a non-flow state. Using both accelerator and 1107 to speed up, 186 is preferred both to reduce the porosity of the potting and to achieve a suitable tack-free time.

MECHANICAL PROPERTIES

45150 (INIS-mf—4542, pp vp) **Structural mechanics in reactor technology.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this paper a refined nonlinear three-dimensional mechanical model for reinforced concrete is presented which can include the effects, depending on the given state of stress. The model is composed of three model-elements: component u-uncracked reinforced concrete with perfect bond (stiffness equal to the sum of the stiffnesses of concrete and reinforcement), component r-reinforcement free in surrounding concrete (reinforcement and concrete are having equal normal strains in noncracked directions and equal shear strains), component c-crack-part (shear stiffnesses in cracks is equal to the sum of shear stiffnesses of the reinforcement mesh, interface shear transfer and dowel action in cracks). The stress tensor of all components is equal to the global stress tensor. The strains are different from component to component corresponding to the local strain distribution in cracked reinforced concrete. For example the uniaxial behavior of reinforced concrete is modelled out of three springs k(u), k(r) and k(c) in series each having variable length l(u), l(r) or l(c). The uncracked structure is represented by k(u) only, l(r) and l(c) are zero. After cracking l(r) and l(c) are growing with the tensile load. When concrete tension stiffness between cracks has diminished, l(u) has reached the zero-value. The stress-dependent weights of the components in the model are derived from uniaxial theory and uniaxial test results.

45151 (SAND—79-0527C) **Identification of the elastic constants for composites using modal analysis.** Carne, T.G.; Wolf, J.A. Jr. (Sandia Labs., Albuquerque, NM (USA); General Motors Research Labs., Warren, MI (USA)). Mar 1979. Contract AC04-76DP00789. 13p. (CONF-790503—5). Dep. NTIS, PC A02/MF A01.

From Spring meeting of society for experimental stress analysis; San Francisco, CA, USA (20 May 1979).

A new procedure is described for determining the elastic constants of isotropic materials based on an impact vibration test of freely supported panels. It is an attractive alternative to currently used techniques because of the ease and speed with which the determinations can be made. This procedure is particularly applicable to fiber-reinforced composites, since the calculations yield average elastic constants rather than those of a small localized specimen of the material. As an overall test of the accuracy of the procedure, panels of known metallic materials are evaluated; and the values of their elastic constants are reproduced to within 3% of their reference values.

POLYMERS AND PLASTICS

45152 **Polymer systems in geothermal applications.** Zeldin, A.; Kukacka, L.E.; Carciello, N. (Brookhaven National Lab., Upton, NY). *J. Appl. Polym. Sci.;* **23**: No. 11, 3179-3191(1 Jun 1979).

The feasibility of using a copolymer composed of styrene, acrylonitrile, and acrylamide or methacrylamide in the formation of a high-strength thermally and chemically stable polymer concrete for use in geothermal environments has been demonstrated. Specimens produced with the copolymer in conjunction with an aggregate containing sand and portland cement had compressive strengths in the range of 25,000 to 30,000 psi at 20°C and were thermally stable up to ~ 240°C. A study of the effect of monomer concentration on the properties of the polymer concrete indicated that the optimum concentration is in the range of 12 to 13 wt %. Increased monomer concentrations lead to a nonuniform polymer distribution within the composite, resulting in a deterioration of the properties. The optimum properties are obtained when the monomer is used in conjunction with an aggregate containing 70 to 80 wt % silica sand and 20 to 30 wt % portland cement. The results from laboratory and field evaluations in progress indicate that the materials can be used for pipe or as protective liners on pipe and vessels in electric generating and direct utilization geothermal proceses. 7 figures, 5 tables.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 45195

45153 (BDX—613-2157(Rev.)) **Improving bondability to RTV silicone elastomer using rf-activated gas.** Bellah, J.L. (Bendix Corp., Kansas City, MO (USA)). May 1979. Contract EY-76-C-04-0613. 24p. Dep. NTIS, PC A02/MF A01.

The effects of an rf-activated gas (plasma) on the bondability to RTV silicone elastomer were studied. Processing guidelines were developed, and a method was sought to satisfactorily bond RTV to the walls of a machined aluminum casting and to provide a surface on the RTV which would best accept bonding to an epoxy encapsulant. Processing parameters, such as gas type and flow rate, reaction chamber pressure, and rf power level, were developed.

45154 (SAND—79-0930C) **Method for accelerated aging under combined environmental stress conditions.** Gillen, K.T. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 10p. (CONF-790632—1). Dep. NTIS, PC A02/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

An accelerated aging method which can be used to simulate aging in combined stress environment situations is described. It is shown how the assumptions of the method can be tested experimentally. Aging data for a chloroprene cable jacketing material in single and combined radiation and temperature environments are analyzed and it is shown that these data offer evidence for the validity of the method.

MECHANICAL PROPERTIES

45155 **Oscillatory necking in polymers.** Matkowsky, B.J.; Sivashinsky, G.I. (Northwestern University). *Q. Appl. Math.;* **37**: No. 1, 23-34(Apr 1979).

The phenomenon of oscillatory necking in the stretching of polyethylene films is described. We propose an extension of a model of Barenblatt for isothermic necking in polymers, and we show that oscillatory necking may arise, for example, in polymers for which the effect of diffusion of stresses exceeds that of diffusion of oriented material. In such polymers, at sufficiently low temperatures, uniform necking is no longer stable and self-oscillations are observed.

PHYSICAL PROPERTIES

45156 **Mean excitation energy of polystyrene.** Ashley, J.C. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B: Condens. Matter;* **19**: No. 10, 5429-5430(15 May 1979).

The mean excitation energy of polystyrene has been evaluated from the dielectric function for this organic solid. The result, I = 68.7 eV, is in good agreement with a value in the literature obtained using the more conventional technique of extracting this parameter from stopping-power data.

OTHER MATERIALS

REFER ALSO TO CITATION(S) 44501

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 44480, 44485, 44486, 44487, 44488, 44489, 44490, 44493, 44494, 44496, 44516, 44517, 44627

45157 (CONF-761168—(Summ.), pp 79-80) **Future topics in basic nucleation and growth research.** Poppa, H. (NASA Ames Research Center, Moffett Field, CA). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

An adequate knowledge of nucleation and growth processes leads to the design and manufacture of thin film deposits of desired properties. Research in randon heterogeneous nucleation, epitaxial nucleation and growth, angstrom-particle chemistry, and surface replication with atomistic resolution is discussed. (FS)

45158 (CONF-761168—(Summ.), pp 81-103) **Fundamentals of evaporation and condensation phenomena.** Munir, Z.A. (Univ. of California, Davis). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Fundamental relationships governing evaporation and condensation processes are reviewed. The terrace-ledge-kink (TLK) model is discussed in terms of atomic steps comprising growth and evaporation of crystals. Recent results in the field are described. (FS)

45159 (CONF-761168—(Summ.), pp 104-105) **Considerations concerning the structure of thin films.** Dove, D.B. (Univ. of Florida, Gainesville). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

The structure and production of single crystalline, polycrystalline, and amorphous thin films are briefly discussed. (FS)

45160 Stress in thermal SiO_2 during growth. EerNisse, E.P. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Appl. Phys. Lett.;* **35**: No. 1, 8-10(1 Jul 1979).

Stress present in thermal SiO_2 at temperatures during growth in wet O_2 has been measured as a function of growth temperature. During growth at 950 °C and below, compressive stress on the order of 7×10^9 dyn/cm² is generated in the SiO_2. During growth at 975 and 1000 °C, the SiO_2 grows in a stress-free state. The results, which are consistent with a viscous flow point somewhere between 950 and 975 °C, are of value in avoiding mechanical failure effects in integrated-circuit processing.

45161 Twenty-second symposium on the art of glassblowing. Wilmington, DE; American Scientific Glassblowers Society (1978). 107p. (CONF-770634—).

From 22. American Scientific Glassblowers symposium; Boston, MA, USA (19 Jun 1977).

A survey is reported of ancient glass technology: flameless electric heaters; borosilicate, quartz, and sapphire windows; mechanical glassblowing; tubular quartz to molybdenum seals; diffusion bonding; glass fluorescence cells; glassblowing training; solar energy applications; fast evacuation of heated dewars; and a versatile multiple outlet semi-ball and socket valve. (FS)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 44479, 44575, 45159, 45165

45162 (LBL—9006) Mullitization of kaolinite and Al_2O_3—SiO_2 mixtures. Johnson, S.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 56p. Dep. NTIS, PC A04/MF A01.

Thesis.

Mullite formation from Al_2O_3—SiO_2 mixtures and kaolinite was studied. The effects of impurities present in kaolinite - TiO_2, Fe_2O_3, Na_2O, K_2O - as well as CaO, on crystal size and morphology were compared. The most pronounced effects were observed when Fe_2O_3 and CaO were added to Al_2O_3—SiO_2 mixtures and to kaolinite. Calcium oxide additions increased the mullite crystal size while iron oxide additions to the Al_2O_3—SiO_2 mixture not only increased the crystal size but also changed the crystal morphology from rectangular to acicular crystals reminiscent of kaolite. Scanning electron microscopy was used to study the specimens. Four kaolinites were also examined by differential thermal analysis. The appearance of an exothermic peak at ~ 1400°C was tentatively linked to the state of order of the kaolinites.

45163 Structure and properties of $SnMo_6S_8$ single crystals. Alekseevskii, N.E.; Dobrovol'skii, N.M.; Kiosse, G.A.; Malinovskii, A.T.I.; Markus, M.M.; Radautsan, A.S.I.; Samus', D.P. (Institute of Applied Physics, Academy of Sciences of the Moldavian SSR). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 9, 667-668(Sep 1978).

An x-ray structural analysis was performed on $SnMo_6S_8$ obtained by the method of gas-transport reactions in a halide atmosphere. In addition to the crystal structure, the superconducting properties of the monocrystal were investigated. (AIP)

PROPERTIES

REFER ALSO TO CITATION(S) 44481, 44482, 44485, 44512, 44516, 44517, 44518, 44520, 44521, 44950, 45163, 45174

45164 (CONF-761168—(Summ.), pp 49-54) **Mechanical integrity of thin films.** Hoffman, R.W. (Case Western Reserve Univ., Cleveland, OH). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Mechanical considerations starting with the initial film deposition including questions of adhesion and grading the interface are reviewed. Growth stresses, limiting thickness, stress relief, control aging, and creep are described. (FS)

45165 (CONF-790538—11) **Protonic conduction of hydrogen impurities in K_2OsCl_6.** Willemsen, H.W.; Armstrong, R.L.; Meincke, P.P.M. (Argonne National Lab., IL (USA); Toronto Univ., Ontario (Canada)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

Dielectric measurements as a function of temperature and frequency in single crystal K_2OsCl_6 with defects containing protons are reported. The results are consistent with a model which assumes the defect state to be a simple interstitial proton which is hydrogen bonded to the nearest neighbor chlorine ions. Temperatures greater than 180 K shows that proton diffusion is thermally activated with a mobility of 10^{-3}cm²/V-sec whereas below this temperature it is determined by quantum tunneling between localized states.

45166 Thermochemical coloration and annealing of spinel and magnesium oxide. White, G.S.; Lee, K.H.; Crawford, J.H. Jr. (Department of Physics and Astronomy, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514). *Appl. Phys. Lett.;* **35**: No. 1, 1-3(1 Jul 1979).

Heating spinel ($MgAl_2O_4$) single crystals in aluminum or magnesium metal vapor at temperatures in excess of 1800 °C results in the introduction of an optical absorption band at 5.3 eV. The same band can be produced by heating in a strongly reducing atmosphere with no metal vapor at 2100 °C. These results strongly support the suggestion of Bunch that the 5.3-eV band, created by atomic displacement collisions resulting from energetic particle bombardment, is associated with an F-type center. Isothermal annealing of the 5.3-eV band in $MgAl_2O_4$ and the 5.0-eV band in MgO introduced by thermochemical coloration suggests that the activation energy for oxide-ion vacancy motion is, respectively, 1.8 and 3.4 eV.

45167 Wavelength-selective bleaching of the optical spectra of trapped electrons in organic glasses. II. Paraszczak, J.; Willard, J.E. (Department of Chemistry, University of Wisconsin, Madison, Wisconsin 53706). *J. Chem. Phys.;* **70**: No. 12, 5823-5833(15 Jun 1979).

Further resolution of the inhomogeneous optical spectra of trapped electrons (e^-/sub t/) in organic glasses has been obtained from wavelength selective bleaching and thermal decay studies on 3-methylpentane-d_{14}(3MP-d_{14}) and 2-methyltetrahydrofuran (MTHF) following γ irradiation in the temperature region of 20 K, and limits on the degree of resolution achievable have been indicated. Exposure of 3MP-d_{14} to light of wavelengths >2100 nm (from a tunable laser) reduces the optical densities at the bleaching wavelength and longer to zero, while "peeling off" a portion of the O.D. at all shorter wavelengths but leaving the remainder of the spectrum unaffected. The fraction of the integrated optical spectrum, $\int$OD d (eV), removed by bleaching at each wavelength tested, and also by thermal decay, is equivalent to the fraction of the total e^-/sub t/ spins removed and measured by ESR. 1064 nm light bleaches the spectrum nearly uniformly, confirming that the spectra of all of the e^-/sub t/ have blue tails with similar ease of bleaching. Heretofore unobserved low temperature thermal decay of e^-/sub t/ occurs at 20 and 40 K (20% of the spin concentration in 30 min, 35% in 3h). The rate of decay of the optical spectrum decreases with decreasing wavelength of observation (2.5, 2.2, 1.8, and 1.5 μ), but at each wavelength is the same at 40 K as at 20 K, consistent

45168 Laser radiation of cadmium sulfide crystals under excitation by pulsed bremsstrahlung x rays. Tarasov, M.D.; Balakin, V.A.; Lobov, S.L.; Pavlovskaya, N.G.; Sidoruk, A.M.; Tsukerman, V.A. *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 8, 584-585(Aug 1978).

Thermoluminescent dosimeters were employed to detect laser radiation from a 3 x 3 x 6 mm crystal of CdS. The power and temporal properties of the laser radiation were studied. The experiment was performed at 120° K. (AIP)

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 44950

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 44755, 45167

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 45324

45169 Nondestructive assay of highly enriched spent fuel. Phillips, J.R.; Hsue, S.T.; Hatcher, C.R.; Kaieda, K.; Medina, E.G. (Univ of Calif, Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* **7**: 464-474(1978).

Passive gamma-ray and neutron measurements have been made on irradiated MTR fuel at the Omega West Reactor. Detectors utilized include a Ge(Li) for gamma spectroscopy, a U-235 fission chamber for thermal neutrons, and a smaller U-235 fission chamber with a beryllium photoneutron converter for detecting gamma-rays above 1.7 MeV. Measurements confirm that burnup can be closely correlated with the Cs-134/Cs-137 ratio. A comparison of activity profiles taken with the three detectors indicates that the method

based on ($gamma$, n) reactions in beryllium is a promising technique.

CHEMICAL PROCEDURES

45170 Free metal and free ligand concentrations determined from titrations using only a pH electrode. Partial derivatives in equilibrium studies. Avdeef, A.; Raymond, K.N. (Univ. of California, Berkeley). *Inorg. Chem.;* **18**: No. 6, 1605-1611(Jun 1979).

In the studies of metal complex equilibria in aqueous solutions, the variation techniques presented by Osterberg, Sarkar, Kruck, and McBryde allow one to calculate free metal and free (unassociated) ligand concentrations from titration experiments using only a pH electrode. The method makes no assumptions about the associated species present in solution and is thus model independent. An alternate general derivation of the expressions and attempt to clarify the technique are presented. Although the approach described is applicable to any number of components (metals, ligands), in a manner analogous to Hedstroem's treatment of two-component systems we treat the three-component system by introducing six Jacobian unit determinants for the six variables (M, L, H, m, l, h), that is, the three total and three free concentrations of the metal, ligand, and hydrogen respectively. These Jacobians are very useful in deriving numerous variational expressions. Using computer-generated data, the techniques were tested under a variety of conditions. A useful Fortran computer program is discussed. A simple technique for analytically evaluating implicit functions such as (∂pH/∂M)/sub L/ or (∂pH/∂L)/sub M/ is presented. This enables one to avoid the use of numerical methods in the least-squares refinement of formation constants, thus leading to substantial reduction in the computational effort. 6 figures, 13 tables.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 44404, 45169

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 45179, 45354

45171 Metal cluster chemistry: structure and stereochemistry in the polynuclear rhodium hydrides H/sub n/Rh/sub n/[P(OR)$_3$]/sub 2n/. Brown, R.K. (Argonne National Lab., IL); Williams, J.M.; Fredrich, M.F.; Day, V.W.; Sivak, A.J.; Muetterties, E.L. *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 5, 2099-2102(May 1979).

Crystallographic analyses of x-ray and neutron diffraction data have provided a definitive structural representation of $(HRh[P(O\text{-}i\text{-}C_3H_7)_3]_2)_2$ and $(HRh[P(OCH_3)_3]_2)_3$. These polynuclear hydrides are generated from square planar $H_2Rh[P(OR)_3]_2$ units by edge (hydrogen atom) sharing and by vertex (hydrogen atom) sharing to form the dimeric and trimeric structures, respectively. The square-planar units are held together through four-center and three-center two-electron Rh—H—Rh bonds in the dimer and trimer, respectively. The dimer and trimer molecules each add one molecule of hydrogen to form $H[i\text{-}C_3H_7O)_3P]_2RhH_3Rh[P(O\text{-}i\text{-}C_3H_7)_3]_2$ and $H_3Rh_3[P(OCH_3)_3]_6$, respectively. NMR spectral information has served to define the stereochemical features of these polyhydrides. The significance of this chemistry in the metal cluster—metal surface analogy is described.

45172 Carbon-13 NMR spectroscopy of [20%-1,2-$^{13}C_2$-Gly^6]-bradykinin. Role of serine in reducing structural heterogeneity. London, R.E. (Los Alamos Scientific Lab., NM); Stewart, J.M.; Williams, R.; Cann, J.R.; Matwiyoff, N.A. *J. Am. Chem. Soc.;* **101**: No. 9, 2455-2462(25 Apr 1979).

Substitution of a glycine residue for the serine residue at position six in the nonapeptide bradykinin leads to a dramatic increase in the cis/trans ratio about the sixth peptide bond (~ 38% cis). Decreases in the cis/trans ratio determined by NMR in 1 M $NaClO_4$ and in 60% $^{13}CH_3OH$ have been correlated with decreases in the 219-nm CD band. Chemical shifts of the 20% ^{13}C-labeled Gly^6 residue exhibit a very different pattern from that observed in the dipeptide Gly-L-Pro; the cis-trans shift difference is ~ 0 ppM for the glycine carbonyl resonances and ~ 1.1 ppM for the glycine methylene resonances. In contrast, the cis- and trans-glycine carbonyl resonances are resolved in 60% methanol and in 1 M $NaClO_4$. A series of model peptides has been examined to determine the structural factors leading to the observed shift pattern. These studies indicate the importance of Phe^8 both in determining the cis/trans ratio and in producing the observed chemical shifts. Glycine resonances in the tripeptide Gly-Pro-Phe are qualitatively similar to those observed in [Gly^6]-bradykinin. The most probable explanation of these data is a favorable hydrophobic/solvent-excluding Pro/Phe association in the cis peptide, which leads to a rotation about the Pro C/sub α/carbonyl bond, placing the carbonyl oxygen in close proximity to the Gly^6 methylene carbon. In the trans peptide, electrostatic repulsion between the Gly and Pro carbonyl oxygens opposes this effect. Significant differences in the cis/trans ratios between bradykinin and [Gly^6]-bradykinin have prompted careful bioassay studies, which show the potency of [Gly^6]-bradykinin to be only 50 to 70% that of bradykinin, although at saturating levels of peptide the responses are within experimental error. These data provide clues about the functional role of serine in bradykinin. 7 figures, 3 tables.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 44329, 45182

INORGANIC AND PHYSICAL CHEMISTRY

45173 Franck—Condon theory of chemical dynamics. VI. Angular distributions of reaction products. Vila, C.L.; Zvijac, D.J.; Ross, J. (Deparment of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *J. Chem. Phys.;* **70**: No. 12, 5362-5375(15 Jun 1979).

We calculate planar and three-dimensional angular distributions for the products of atom—diatom chemical reactions by means of the Franck—Condon (FC) model. The wave functions on the reactant and product quasiadiabatic surfaces are expanded in partial wave series. A local uncoupling of the different degrees of freedom is assumed and consequently the individual members of the partial wave series can be separated into products of angular factors and rovibration—translation factors. To evaluate these factors, we consider the limit of weak and strong potential, and weak and strong kinematic couplings. The center-of-mass differential cross section is obtained by means of the T matrix formalism. For assumed LEPS surfaces of the systems $H+H_2 \rightarrow H_2+H$, $H_2+F \rightarrow HF+H$ and $H+Cl_2 \rightarrow HCl+Cl$, we calculate angular distributions of reaction products in the various coupling limits for ranges of final states.

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 44419, 45187, 45347, 45348

45174 SF_6 condensation in supersonic nozzle expansions. Fisher, S.S. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **22**: No. 7, 1261-1279(Jul 1979).

The condensation of SF_6 in a dilute mixture with either Ar or He as a carrier gas when quickly expanded in a small, adjustable nozzle is investigated. Condensation is observed by monitoring the disappearance of individual rotational-state lines in the SF_6 ν_4 absorption band. For this, a diode-laser spectroscopy system is employed, the nozzle is two dimensional, and the flows are short-duration pulses. The gas density at which condensation onset occurs is measured as a function of local gas temperature (30°—100° K), local expansion rate, and SF_6 mole fraction (0.18%—3.4%). The onset density depends strongly on the local temperature and expansion rate and not at all on the mole fraction. For the SF_6/Ar data, Ar co-condensation appears to reduce the SF_6 onset density level at the lowest mole fractions, and SF_6 vibrational lag appears to increase the onset density level at the highest mole fractions. A simple "trimers-critical" model for condensation onset is derived, and with this model reasonable correlation of much of the onset data is obtained. From this correlation, an effective dimer binding energy and trimer formation probability are extracted.

45175 Reaction of silylphosphine with ammonia. Norman, A.D.; Jolly, W.L. (Univ. of Colorado, Boulder). *Inorg. Chem.;* **18**: No. 6, 1594-1597(Jun 1979).

Silylphosphine (SiH_3PH_2) and NH_3 in the liquid phase react to form PH_3, $(SiH_3)_2NH$, and $(SiH_3)_3N$. No evidence for SiH_3NH_2 as an intermediate in the exchange processes could be obtained. Subsequent NH_3-promoted elimination of SiH_4 from silazane molecules yields a series of silazane oligomers and polymers. Two new condensation oligomers, $(SiH_3NH)_2SiH_2$ and $(SiH_3)_2NSiH_2N(H)SiH_3$, have been obtained in low yield. Chemical and spectral characterization data for the new silizanes are given. Possible mechanisms for the observed series of exchange and redistribution processes are discussed. 3 figures, 1 table.

45176 Preparation, structure, and spectral characterization of Bis[D-β-(2-pyridyl)-α-alaninato]cobalt(III), Co(D-Pyala)$_2^+$. Ebner, S.R.; Jacobson, R.A.; Angelici, R.J. (Ames Lab., IA). *Inorg. Chem.;* **18**: No. 3, 765-770(Mar 1979).

The complex $[Co(D\text{-}Pyala)_2]NO_3 \cdot {}^1/_2H_2O$ was prepared by reaction of Co(II) or Co(III) with D-$H_2NCH(CH_2C_5H_4N)CO_2^-$, D-Pyala$^-$, the tridentate analogue of histidine. It was established by an X-ray crystal study of the complex that of the three possible isomeric forms, the most stable was that in which the carboxylate groups of the two ligands are mutually trans. This structure contrasts with that

of the predominant isomer of the histidinate complex $Co(L\text{-}his)_2^+$, in which the imidazole groups are mutually trans. Infrared, ^1H NMR, visible, ORD, and CD spectra of $Co(D\text{-}Pyala)_2^+$ are discussed and are entirely consistent with the solid-state structure. 4 figures, 4 tables.

45177 Structure of sodium diaquobis(benzene-1,2-dioxydiacetato)lanthanate(III) tetrahydrate. Kerfoot, H.B. (Florida State Univ., Tallahassee); Choppin, G.R.; Kistenmacher, T.J. *Inorg. Chem.;* **18**: No. 3, 787-790(Mar 1979).

The crystal structure of sodium [diaquobis(benzene-1,2-dioxydiacetato)lanthanate(III)] tetrahydrate, Na[La(H/sub 2~/O)$_2$($C_{10}H_9O_8$)$_2$].4H_2O, is reported. Crystals obtained from aqueous solution are triclinic, space group Pantil, with α = 12.350 (4) A, b - 12.760 (3) A, c =8.783 (3) A, α = 101.54 (2)°, β = 95.28 (2)°, γ = 75.98 (2)°, Z = 2,d/sub mcasd/ = 1.86 (2) g cm^{-3}, and d/sub calcd/ = 1.81 g cm^{-3}. Standard heavy-atom methods were employed in the structural solution. Full-matrix, least-squares refinement of the non-hydrogen atom parameters, based on 4337 counter-collected F/sub o/'s, led to a final R value of 0.041 and a final weighted R value of 0.054. The lanthanum ion is decacoordinate, with a primary coordination sphere comprised of two tetradentate benzene-1,2-dioxydiacetate ligands and two water molecules. The coordination polyhedron about the lanthanum ion approximates a s-bicapped square antiprism, with typical La—O separations. Individual sodium ions are hexacoordinate, and inversion-related sodium coordination polyhedra together form a distorted, edge-shared bioctahedron. The novel aspect of the structure is the multiple bridging between the lanthanum and sodium ion coordination spheres, primarily through the benzene-1,2-dioxydiacetate ligands. The molecular conformation of the lanthanum complex observed in this structure does not duplicate that found in solution by NMR techniques. These conformational differences are attributable to interactions involving the coordinating sodium ion and other crystal packing forces not expected to be present in solution. 5 figures, 4 tables.

45178 Structural studies of precursor and partially oxidized conducting complexes. 18. Synthesis, crystal structure, and X-ray diffuse scattering studies of the new partially oxidized tetracyanoplatinate complex $Cs_2[Pt(CN)_4](N_3)_{0.25}.0.5H_2O$[1]. Brown, R.K.; Vidusek, D.A.; Williams, J.M. (Argonne National Lab., IL). *Inorg. Chem.;* **18**: No. 3, 801-804(Mar 1979).

We report the first synthesis and X-ray structure study of a partially oxidized tetracyanoplatinate complex containing azide ion, $Cs_2[Pt(CN)_4](N_3)_{0.25}.0.5H_2O$. This one-dimensional conducting salt crystallizes in the tetragonal space group P4b2[D/sub 2d/^{7}, No. 117] with cell dimensions a = 13.089 (2) A, c = 5.754 (1) A, and V = 985.8 A^3 and with a calculated density of 3.94 g/cm^3 for four formula units per cell. A total of 4358 observed data were averaged to yield 1584 independent reflections of which 1362 had $F_o^2 > \sigma(F_o^2)$. The structure was solved by standard heavy-atom methods and was refined by full-matrix least-squares to a final $R(F_o^2)$ = 0.068 and R/sub w/(F_o^2) = 0.088. The crystal structure consists of perfectly linear chains of Pt atoms with Pt—Pt separations crystallographically constrained to a value of c/2 = 2.877 (1) A and interchain Pt—Pt distances of 9.255 (2) A. Using X-ray diffuse scattering techniques we have established the Pt oxidation state as 2.25)20. The crystal structure is pseudo body centered and nearly isomorphous with the tetracyanoplatinate complexes $M_2[Pt(CN)_4](FHF)$/sub x/[M=Cs(x=0.39, 0.23) and M=Rb(x=0.40)]. 3 figs, 2 tables.

45179 Zirconium dichloride phase region. Synthesis, structure, and photoelectron spectral studies of 3R-$ZrCl_2$, 6T-$Zr_{1.05}Cl_2$, and related phases. Cisar, A. (Ames Lab., IA); Corbett, J.D.; Daake, R.L. *Inorg. Chem.;* **18**: No. 3, 836-843(Mar 1979).

Homogenous compositions and several phases between $ZrCl_{1.5}$($Zr_{13}Cl_2$) and $ZrCl_{2.0}$ have been synthesized in sealed Ta tubing by both chemical transport reactions and isothermal equilibrations at 600 to 750°C for 4 to 10 weeks. X-ray powder and single-crystal diffraction results indicate the breadth of the composition range is probably achieved through the formation of ordered superstructures derived from the basic three-layer slabs of the parent 3R-$ZrCl_2$ type with ordered interstitial atoms and with extensive intergrowth and twinning, the individual phases showing small if not negligible homogeneity ranges. The structure of the stoichiometric 3R-$ZrCl_{2.00}$/sub (1)/ was refined using 98 independent reflections ($2\theta \leq 60°$), space group R3m, a = 3.3819 (3) A, c = 19.378 (3) A, to R = 0.094 and R/sub w/ = 0.074. The structure consists of homoatomic layers sequenced Cl-Zr-Cl with trigonal prismatic coordination of the metal by halide (D/sub 3h/), isostructural with the isoelectronic 3R-MoS_2. The phase could not be intercalated. A previously reported powder pattern of $ZrCl_2$ is found to be that of monoclinic ZrO_2. A structure of 6T-$Zr_{1.047}$/sub(5)/Cl_2 (a = 3.3791 (4) A, c = 38.713 (7) A, space group Panti3ml) was approximated from a crystal in which it was a minor component coherently intergrown with 3R-$ZrCl_2$)obverse and reverse) through refinement of 266 1-odd reflections (R=0.256). Photoelectron spectra are reported for most of the reduced zirconium chlorides. $ZrCl_2$ shows a narrow metal band 1.2 eV below E/sub F/, well above this feature in the isoelectronic MoS_2, and is analogously a semiconductor (E/sub g/$\approx$0.3 eV). A metal valence band was not detected in $ZrCl_3$, and there is an abrupt increase in the Zr(3d) core levels at that point relative to more reduced phases. 4 figures, 2 figures.

45180 Composition dependence of elasticity in Na/sub x/WO_3. Benner, R.E. (Univ. of Rochester, NY); Brody, E.M.; Shanks, H.R. *J. Solid State Chem.;* **27**: No. 3, 383-388(Mar 1979).

Single crystal Na/sub x/WO_3 elastic constants have been measured for x = 0.522, 0.628, 0.695, and 0.74 using Brillouin light scattering. The elasticity of Na/sub x/WO_3 is found to be similar to that of ReO_3. Calculations indicate that an observed decrease in c_{11} with increasing sodium concentration results from perturbation associated with an increasing lattice constant of strong, covalent W—O bonds.

45181 Mulliken electronegativity scale and the structural stability of simple compounds. Watson, R.E.; Bennett, L.H. (Brookhaven Natl Lab, Upton, NY). *J. Phys. Chem. Solids;* **39**: No. 11, 1235-1242(1978).

A new electronegativity scale is derived, in the spirit of Mulliken's original scheme, in terms of neutral atom spectroscopic data. The effect of changing the atomic configuration for C from covalent (sp^3) to metallic (s^2p^2) is considered. Structural stability maps are presented for non-octet non-transition metal compounds, and for two classes of transition metal-non-transition-metal compounds.

45182 Process for purifying mercuric iodide as a base material used for growing high grade crystals. Schieber, M.M. (to Energy Research and Development Administration, Washington, DC (USA)). French Patent 2,316,192/A/. 29 Jun 1976. 10p. (In French).

A process is described for purifying mercuric iodide as a base material used for growing high grade crystals, in the following successive stages: preparing the mercuric iodide by synthesis from mercury and iodine, repeated sublimation of the mercuric iodide prepared by synthesis then refining the re-sublimated powder by area.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 45172, 45176, 45177

45183 Reaction of unsaturated compounds with hypofluorous acid. Migliorese, K.G.; Appelman, E.H.; Tsangaris, M.N. (Argonne National Lab., IL). *J. Org. Chem.;* **44**: No. 10, 1711-1714(11 May 1979).

The reactions of hyperfluorous acid with organic substrates were studied. A U-tube containing the HOF was warmed to -50°C and the swept HOF from the U-tube with dry nitrogen into a cold solution of the alkene or alkyne in dichloromethane or carbon tetrachloride. Major products were characterized by gas chromatography, mass spectrometry, infrared spectrophotometry, and F/H nuclear magnetic resonance spectrometry. Alkenes gave α-fluoro alcohols as the major products, while acetylenes gave mixtures of aldehydes, ketones, and acyl fluorides. In most cases, the expected Maikownikoff addition products were formed. The interplay of the various mechanistic factors is quite complex, and further work is necessary. 1 table.

45184 Reduction of azanaphthalenes by sodium borohydride in trifluoroacetic acid. Bugle, R.C.; Osteryoung, R.A. (Colorado State Univ., Fort Collins). *J. Org. Chem.;* **44**: No. 10, 1719-1720(11 May 1979).

A method for the reduction of a variety of azanaphthalenes in good yield under generally mild conditions compatible with the presence of many functional groups is described. Treatment of quinoxaline and quinazoline with sodium borohydride and TFA resulted in the formation of 1,2,3,4-tetrahydroquinoxaline and 1,2-dihydroquinazoline in respectively 90% and 85% recovery. Pyride pyrazine was reduced cleanly and regiospecifically to pyrido [2,3-b]-1,2,3,4-tetrahydropyrazine in 75%. No evidence could be found by TLC that reduction had occurred within the pyridine ring, and it appeared that a pyrazine ring system could be preferentially reduced within a mixed heteroaromatic nucleus. The reduction of pteridine with sodium borohydride and TFA yielded two components in an overall recovery of 94%. The two components were identified by ^{13}C and proton magnetic resonance as 5,6,7,8-tetrahydropteridine and 1,2,3,4-tetrahydropteridine in 58% and 38% yields, respectively. The ability of sodium borohydride and TFA to reduce pteridine to both tetrahydro products provided a synthetic potential for these reagents which had not been previously realized. The structures

assigned to the compounds reported were confirmed by proton magnetic resonance, ^{13}C NMR and mass spectrometric data. These reduction products are relatively thermally stable and resistant to fragmentation so that molecular ions could be observed during mass spectrometric analysis. 1 table.

45185 Theoretical study of the reactions of ethene with diimide species. Pasto, D.J.; Chipman, D.M. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **101**: No. 9, 2290-2296(25 Apr 1979).

Ab initio SCF calculations have been carried out on the minimum energy pathways for reduction of ethane by Cis-, trans-, and 1,1-diimide, Cis- and 1,1-diimide each undergo synchronous transfer of hydrogen to ethene (diimide reduction) with 4-31G energy barriers of 26.7 and 45.8 kcal/mol, respectively. The present result with cis-diimide is in distinct contrast with the results of a previous calculation which gave an energy barrier of ~ 60 kcal/mol. trans-Diimide reacts with ethene by either of two equally favorable pathways: (1) an indirect process corresponding to prior isomerization to cis-diimide with a 4-31G energy barrier of 46.0 kcal/mol; (2) a direct 1,3-addition to ethene to produce ethylaminonitrene with a 4-31G energy barrier of 45.3 kcal/mol. Various modes of decomposition of alkylamino- and dialkylaminonitrenes have been explored, the most favorable pathway apparently being a two-step, homolytic dissociation in which cleavage of the first C-N bond is the slow step. Concerted rearrangement of aminonitrene to trans-diimide is a forbidden process possessing a 4-31G energy barrier of 81.5 kcal/mol. The results of this theoretical study are discussed in terms of the known experimental facts on the diimide reduction reaction and decomposition of dialkylaminonitrenes. 7 figures, 3 tables.

45186 Triplet state of the chlorophyll dimer. Clarke, R.H.; Hobart, D.R; Leenstra, W.R. (Boston Univ., MA). *J. Am. Chem. Soc.;* **101**: No. 9, 2416-2423(25 Apr 1979).

The photoexcited triplet state properties of chlorophyll aggregate systems in vitro were investigated by zero-field optically detected magnetic resonance (ODMR) spectroscopy at 2K. Measurements of the triplet state zero-field splittings, overall triplet lifetimes, and individual spin sublevel intersystem crossing rate constants were obtained for solutions of chlorophyll a and zinc-substituted chlorophyll a and for the covalently linked dimeric derivative of pyrochlorophyllide a. The triplet-state properties found for these systems are interpreted within the framework of the triplet exciton model to assess the applicability of the exciton approach in determining the geometry of chlorophyll aggregate systems and to evaluate structural features of chlorophyll systems proposed as models for in vivo chlorophyll. 3 figures, 4 tables.

45187 Chain mechanism for the autoxidation of the isopropylchromium(III) cation. Ryan, D.A.; Espenson, J.H. (Ames Lab., IA). *J. Am. Chem. Soc.;* **101**: No. 9, 2488-2489(25 Apr 1979).

The unusual reaction of isopropylchromium(III) ion with molecular oxygen in aqueous perchloric acid solution is the subject of this report. Kinetic studies were carried out using both spectrophotometric techniques and an oxygen sensing electrode. An illustration of the 3/2 order rate law comes from a log—log plot of the instantaneous reaction rate vs [CrR^{2+}]/sub av/. A plot incorporating data from a number of runs is shown. The kinetic data and reaction conditions are summarized. The average value of k/sub exp/ is 0.60 +- 0.10 dm/sup 3/2/mol/sup -1/2/s^{-1}. The reaction rate is independent of both hydrogen ion concentration and molecular oxygen concentrations over the ranges studied. The organic products consist of acetone, smaller amounts of 2-propanol, Cr(III), small reproducible yields of $HClO_4^-$. The chain reactionmechanism is discussed. Isopropylperoxochromium(III) cation has been identified as an intermediate. Injection of Fe^{2+} prior to or during the reaction produces a pronounced interruption and reinitiation of the main reaction. This effect can be attributed to its chain breaking reaction with the propagating isopropylperoxyradical. 2 figures.

45188 Photoionization by green light. Thomas, J.K.; Piciulo, P.L. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **101**: No. 9, 2502-2503(25 Apr 1979).

A recent communication showed that the photoionization of aminoperylene by green light (λ=5300 A) directly followed by laser light intensity in the range 30 to 150 mJ/pulse. To avoid ambiguity, two additional areas of experimental data are presented. The dependence of the yield of photoionization on the laser intensity is shown with the original data together with the results of an extension of the experiment to lower laser intensities (8 to 150 J/(cm^2/pulse). A graph shows that the data are linear and extrapolated through the origin. To achieve extremely low light intensities, solutions containing aminoperylene and SF_6 were photoionized in NaLS micelles with light of 1-mW intensity, i.e., much lower than that used in the laser work. Fluoride ion was produced and measured on a fluoride sensitive electrode. Excitation produced the excited singlet state and proceeded to the excited triplet. Absorption by the foregoing solution of 0.31 x 10^{16} and 0.72 x 10^{16} quanta light produced 5.8 x 10^{16} and 12 x 10^{16} F^-, respectively. From the known rate constants for reaction of e/sub aq/$^-$ with O_2 and SF_6, and the fact that e/sub aq$^-$ produces 6F^-, the [e/sub aq$^-$]'s produced in photolysis are 2.1 x 10^{16} and 4.4 x 10^{16} molecules, respectively. The quantum yield for photoionization is thus 6.0 x 10^{-2}. The aminoperylene data have again supported the one-photon ionization of the compound in NaLS micelles. 1 figure.

45189 Solubility of toluene in aqueous sodium alkylbenzenesulfonate solutions. Ho, P.C.; Ho, C.; Kraus, K.A. (Oak Ridge National Lab., TN). *J. Chem. Eng. Data;* **24**: No. 2, 115-118(Apr 1979).

The solubility of toluene in aqueous solutions of nine substituted sodium benzenesulfonates with short side chains was determined at 25 and 55°C using gas chromatography for the analysis of the saturated solutions. Tenax GC, which is used mostly for the separation of high boiling polar compounds, was found suitable for the analysis of aqueous solutions of toluene, a nonpolar, lower boiling compound. The solubility of toluene generally increases with sulfonate concentration except for the lowest members of the series (benzene- and toluenesulfonate) where a slight decrease in solubility (salting out) occurs at low concentrations. Toluene solubility in the aqueous phase generally increases with the number of alkyl carbons on the benzene ring. The compound with the largest number of alkyl carbons studied here (2,5-diisopropylbenzenesulfonate) shows a very high toluene solubility (ca. 1 mol of toluene/mol of sulfonate in 2.5 m sulfonate); its hydrotropic properties thus seem very much larger than of sodium p-cymenesulfonate, frequently cited as the best hydrotropic material available. 3 figures, 3 tables.

45190 Density estimations for explosives and related compounds using the group additivity approach. Tarver, C.M. (Univ. of California, Livermore). *J. Chem. Eng. Data;* **24**: No. 2, 136-145(Apr 1979).

A first-order group additivity approach was used to estimate the densities of 188 explosives and related compounds of very diverse compositions. Of the 173 compounds for which direct comparisons could be made, 40.5% of the estimated densities were within 1% of the measured densities, 33.0% were within 1 to 2%; 16.8% were within 2 to 3%, and 9.8% deviated more than 3% from the measured densities. The average absolute error in density was 0.0191 g/cm^3, and the absolute error in density exceeded 0.05 g/cm^3 for only 14 of the 173 compounds (8.1%). The largest errors occurred for compounds with several bulky highly polar groups in close proximity and for compounds containing groups whose calculated molar volumes were based on density data for a small number of compounds. Inclusion of second-order effects, such as nearest neighbor interactions, phase transitions, and crystalline structure in a second-order group additivity model, appears necessary for accurate density estimations in certain types of compounds. 7 tables.

ISOTOPE EFFECTS

45191 $^{13}C/^{12}C$ and $^{18}O/^{16}O$ liquid—vapor isotopic fractionation factors in CO as a function of temperature. Goetz, D.; Lee, M.W.; Bigeleisen, J. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *J. Chem. Phys.;* **70**: No. 12, 5731-5738(15 Jun 1979).

The carbon and oxygen isotope fractionation factors in the liquid—vapor equilibrium (LVIFF) of carbon monoxide have been determined over the temperature range 81—125° K. The results are in excellent agreement with previous isotopic vapor pressure data which cover the range 68—82° K. The results are analyzed in terms of an anharmonic cell model by the FG matrix method. The anharmonicity is approximated by the use of a temperature dependent F matrix. Analysis of the LVIFF and VPIE data by this method gives good agreement with experiment and the previous theoretical calculation by Gordon of the mean square force, the mean square torque, and the translation rotation coupling at 77.5° K. The present calculations of the mean square force and experimented data on the mean energy in liquid CO are used to derive a set of intermolecular potential parameters for CO using the WCA perturbation theory. If a M-6 potential is assumed, the best fit of all the data is obtained for m=14, ϵ/k=109° K, and σ<3.858A. The latter are consistent with potential parameters derived from second virial coefficients and gas viscosity.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 45181

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 45188, 45433

45192 (PB—284499) **Photonuclear data index, 1973—1977. Special publication.** Fuller, E.G.; Gerstenberg, H.M. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Aug 1978. 104p. NTIS PC A06/MF A01.

This index, a supplement to NBS Special Publication 380, Photonuclear Reaction Data, 1973, primarily covers data published in the period from January 1965 through December 1977. Organized by element and isotope, each entry in the index is for a specific reaction reported in a given reference. Information is given on the type of measurement, excitation energies studied, source type and energies, detector type and angular ranges covered in the measurement. Also included is an index to the more than 1000 data sets currently available in the Photonuclear Data Center's digital data library.

45193 **Temperature effect on the quantum yield for production of S(¹S) from OCS.** Black, G.; Sharpless, R.L. (Molecular Physics Laboratory, SRI International, Menlo Park, California 94025). *J. Chem. Phys.;* **70**: No. 12, 5567-5570(15 Jun 1979).

The production of S(¹S) from OCS, over the wavelength range 142—170 nm, has been investigated at temperatures of 232, 296, and 425°K. Changing the temperature produces no measurable effect on the S(¹S) yield in the region of high quantum yield (142—157.7 nm). In the fall off region (157.7—170 nm), raising the temperature increases the quantum yield with the fractional increase growing to longer wavelengths: to a factor of 1.9 +- 0.4 at 170 nm (for a temperature change from 232 to 425°K). Both rotational and vibrational energy may contribute to the effect but, based on considerations of the photodissociation mechanism in this region, vibrational energy (in the bending mode) is thought to play a more important role.

45194 **Photochemical properties of the low-spin iron(II)—2,3,9,10-tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraene complexes. An investigation of the secondary thermal substitution reactions by laser and flash photolysis.** Ferraudi, G. (Univ. of Notre Dame, IN). *Inorg. Chem.;* **18**: No. 6, 1576-1580(Jun 1979).

The photochemical properties of the Fe(II)—TIM (TIM = 2,3,9,10-tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraene) complexes have been investigated by laser and flash photolysis. Rapid substitution reactions of the metastable products have been observed in photolyses of $Fe(TIM)(NCS)_2$, $Fe(TIM)(imid)_2^{2+}$, and $Fe(TIM)(CH_3CN)(CO)^{2+}$ in acetonitrile. Also, photolysis induces a transient linkage isomerization of the thiocyanate complex and two photolabilization processes, substitution of CO and CH_3CN, in $Fe(TIM)(CH_3CN)(CO)^{2+}$. A precursor, assigned as pentacoordinated $Fe(TIM)(CO)^{2+}$, was detected in laser flash photolysis. Aspects of the photosubstitution processes in Fe(II)—TIM complexes are discussed. 5 figures, 1 table.

RADIATION CHEMISTRY

45195 (AD-A—060672) **Investigative study on the feasibility of utilizing fluorinated ethylene propylene elastomers as protective mask faceblank materials. Final report Jun 1976—Jan 1978.** Sperling, L.H.; Thomas, D.A. (Lehigh Univ., Bethlehem, PA (USA). Materials Research Center). May 1978. Contract DAAA15-76-C-0126. 43p. NTIS PC A03/MF A01.

This paper demonstrates the feasibility of obtaining a tough, transparent crosslinked fluorocarbon elastomer with reduced creep. The linear material exhibits creep and tackiness but is relatively clear. Existing vulcanizing recipes yield opaque, crosslinked materials. Polymerization is accomplished via high energy radiation. The linear fluorocarbon is physically bound up with the crosslinked network formed by the polymerized monomer, producing a semiinterpenetrating polymer network (IPN) of the second kind. The optimum conditions for the synthesis of a fluorocarbon elastomer with the desired properties, appear to be a dose level of 5.0 to 7.5 Mrads of beta radiation and a trimethylolpropane trimethacrylate (TMPTM concentration of 3-5%, based on experiment.

45196 **Radiation-induced emulsion copolymerization of vinyl chloride with vinyl acetate in an engineering flow system.** Tsai, J.T.; Stahel, E.P.; Stannett, V.T. (North Carolina State Univ., Raleigh). *J. Appl. Polym. Sci.;* **23**: No. 9, 2701-2710(1 May 1979).

A flow reactor system was used to study the radiation-induced emulsion copolymerization of vinyl chloride with vinyl acetate. The emulsion was recirculated from a stirred vessel through transfer lines to a tubular reactor located within a high-intensity Co-60 source. The effects of physical chemical variables such as soap concentration, phase ratio, reaction temperature and residence time distribution on the molecular weight properties were investigated. The rate of copolymerization was found to be proportional to the 0.17 power of the soap concentration. Variation of the monomer-water ratio produced no significant change in rate. The rate increased with an increase in temperature over the range 5 to 50°C, while the average molecular weights of the copolymer increased with decreasing polymerization temperature. The molecular weight distribution in this engineering system was found to be essentially similar to those produced in a batch system.

45197 **Pulse radiolytic study of the oxidation of vitamin B/sub 12r/ by dibromide ions.** Meyerstein, D. (Argonne National Lab., IL); Espenson, J.H.; Ryan, D.A.; Mulac, W.A. *Inorg. Chem.;* **18**: No. 3, 863-864(Mar 1979).

Pulse Radiolytic Study of the Oxidation of Vitamin B/sub 12r/ by Dibromide Ions Solutions for pulse radiolysis contained the desired concentration of vitamin B/sub 12r/ and sodium bromide in water and were saturated with nitrous oxide. The conclusions from the study are the following: (a) the reaction of the dibromide ion with B/sub 12r/ proceeds by an inner sphere mechanism, as has been established by direct for some metal complexes including aqueous solutions of $iron^{2+}$, $cobalt^{2+}$, and chromium $^{2+}$, and nitrilotriacetic acid solutions of $cobalt^{2+}$ and $manganese^{2+}$, and organic nickel complexes, (b) the rate constants and concentrations are such that the second step of the reaction proceeds as Br_2^{-}. + [Co(II)] → Br^{-} + Br-[Co(III)], (c) the aquation rate of bromocob(III)alamin can be verified by a completely independent method. 1 figure, 1 table.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 45452

45198 **Tris((hexamethyldisilyl)amido)uranium(III): preparation and coordination chemistry.** Andersen, R.A. (Univ. of California, Berkeley). *Inorg. Chem.;* **18**: No. 6, 1507-1509(Jun 1979).

Red, monomeric, volatile tris((hexamethyldisilyl)amido)uranium(III) has been prepared from uranium trichloride (prepared from uranium tetrachloride and 1 molar equiv of sodium naphthalene in tetrahydrofuran) and sodium (hexamethyldisilyl)amide in tetrahydrofuran. The geometry of this three-coordinate amide is thought to be pyramidal, analogous to that of its congener, neodymium. The tris(silylamide) does not form coordination complexes with a variety of Lewis bases, though the analogous neodymium compound affords 1:1 complexes with t-BuNC and t-BuCN. The uranium amide is oxidized by molecular oxygen or trimethylamine oxide to a uranium(V) species, $OU[N(SiMe_3)_2]_3$. The neodymium tris(silylamide) reacts with the dimethyl sulfide complex of borane affording $Nd(BH_4)_3(THF)_3$. 2 tables.

45199 **Synthesis and structure of Di-n-propylammonium ethoxybis(di-n-propylmonothiocarbamato)dioxouranate-(VI), a mixed-chelate alkoxide of uranium.** Perry, D.L.; Templeton, D.H.; Zalkin, A. (Univ. of California, Berkeley). *Inorg. Chem.;* **18**: No. 3, 879-881(Mar 1979).

Atomic parameters, hydrogen positional parameters, distances, and angles are tabulated. An ORTEP view shows the nonhydrogen atoms and the numbering scheme used for the atoms in the tables. The uranium atom is heptacoordinate and is at the center of a pentagonal bipyramid consisting of two sulfur atoms and five oxygen atoms. The overall molecular structure is compared so that of another dioxouranate complex which has ethyl groups in place of n-propyl groups. In each compound two formula units form a hydrogen-bonded dimer about a crystallographic center of symmetry. These dimers pack in the two crystal lattices with different symmetry, yet corresponding bond distances and angles are in close agreement for the two structure. This consistency indicates that the observed structure is characteristic of the complex and not one which is dominated by molecular packing effects or subject to excessive error. However, the alkyl groups are poorly defined with some large thermal parameters and some bond lengths which are in error. 3 tables, 1 figure.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 44280

ENGINEERING

45200 (CONF-7708113—P1) **Sixth Australasian conference on the mechanics of structures and materials. Volume I. Technical papers.**

(Canterbury Univ., Christchurch (New Zealand)). 1977. 518p. Dep. NTIS (US Sales Only), PC A22/MF A01.

From 6. Australasian conference on the mechanics of structures and materials; Christchurch, New Zealand (22 Aug 1978).

Selected papers were separately processed for the Energy Data Base.

45201 (CONF-7708113—P2) **Sixth Australasian conference on the mechanics of structures and materials. Volume 2. Invited addresses.** (Canterbury Univ., Christchurch (New Zealand)). 1977. 22p. Dep. NTIS (US Sales Only), PC A02/MF A01.

From 6. Australasian conference on the mechanics of structures and materials; Christchurch, New Zealand (22 Aug 1978).

Selected papers were separately processed for the Energy Data Base.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 44971, 45309

45202 (ANL—79-4) **Nondestructive evaluation techniques for silicon carbide heat-exchanger tubes. Annual report, October 1977—September 1978.** Kupperman, D.S.; Yuhas, D.; Sciammarella, C.; Lapinski, N.P.; Fiore, N. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 80p. Dep. NTIS, PC A05/MF A01.

This report discusses the adequacy of several nondestructive evaluation techniques for the detection of flaws in silicon carbide heat-exchanger tubing. Experimental results have been obtained for conventional ultrasonic testing, acoustic microscopy, conventional and dye-enhanced radiography, holographic interferometry, infrared scanning and internal-friction measurements. Calculation of critical flaw size and the advantages and disadvantages of overload proof testing are also discussed. Suggestions regarding preservice as well as inservice inspection of silicon carbide tubing are given, along with a comparison of the effectiveness of the various nondestructive evaluation methods evaluated in this study.

45203 (N—78-33384) **Development of a cryogenic rotating heat pipe joint. Final report, November 1977—September 1978.** (Rockwell International Corp., Downey, CA (USA). Satellite Systems Div.). Sep 1978. Contract NAS2-9726. 72p. NTIS PC A04/MF A01.

The performance of two critical technology components required for a continuously rotatable heat pipe: (1) a low-leakage rotatable coupling for the heat pipe pressure vessel, and (2) a rotatable internal wick, is reported. Performance and leakage requirements were established based on 12 months operation of a cryogenic rotatable heat pipe on a satellite in earth orbit.

45204 (SAND—79-0721) **Method for describing nearly normal penetration of an ogive nosed penetrator into terrestrial targets.** Davie, N.T. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 63p. Dep. NTIS, PC A04/MF A01.

An analytical method is proposed for describing the nearly normal penetration of an ogive nossed earth penetrator into terrestrial targets. This method, based on the concept of an expanding spherical cavity, allows the prediction of axial and lateral forces on the penetrator as well as complete trajectory information. Predictions based on this model compare favorably with experimental results.

45205 (SAND—79-8002) **Terminal data analyzer decommutator: a means for analyzing asynchronous serial data.** Lucero, L.A. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 18p. Dep. NTIS, PC A02/MF A01.

A microprocessor-based decommutator capable of deciphering terminal data analyzer (TDA) information has been designed. This system is able to extract the TDA bus seizure from the rest of the telemetry signal. Up to 15 bus seizures can be extracted at one time. For each TDA bus seizure as many as 15 frames can be selected for analysis. Time, pressure, and other relevant parameters can be printed in desired units. The whole analysis is done in seconds. Among the features of the microprocessor decommutator are its efficiency, simplicity, and flexibility. By simply changing the format parameters via the teletype an operator can set the decommutator to analyze different types of TDA's. This report briefly describes the hardware schemes used by the TDA tester. A detailed development and explanation of the tester software are given. However, rather than a detailed description of subroutines, there is an outline of the basic techniques used.

45206 (UCRL—52654) **Time-dependent propagation of high-energy laser beams through the atmosphere: IV.** Morris, J.R.; Fleck, J.A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1978. Contract W-7405-ENG-48. 36p. Dep. NTIS, PC A03/MF A01.

Calculations are presented for combined t^3-blooming and overlap blooming of a multipulse laser beam whose beam shape is a uniformly illuminated square aqerture. Thermal conduction and intensity saturation models for simulation of laboratory-scale (small beam-diameter) experiments are described. A comparison of experimental data with calculation of combined t^3-blooming and overlap blooming is discussed. A return-wave algorithm for computing phase compensation for steady-state cw or multipulse thermal blooming of lasers that emit significant radiation on more than one spectral line is described. Each line can have an independent wavelength, beam shape, and phase distribution. Multiline lasers with sufficiently similar intensity distributions on different lines can be accurately modeled with a simple power-weighted average absorption coefficient, but this property must be verified (rather than assumed) for each actual multiline laser. In full-up propagation codes, increasing the wavelength by a common factor everywhere it occurs is shown to be the only viable wavelength-scaling algorithm for modeling non-diffraction-limited laser beams. Any other choice modifies the geometric-optics behavior of the thermal blooming.

45207 **Gage for micromachining system.** Miller, D.M. (to Dept. of Energy). US Patent 4,141,150. 27 Feb 1979. Filed date 14 Dec 1977. 24p.

PAT-APPL-861,074.

The invention discloses a gage for measuring the contour of the surface of an element of a micromachining tool system and of a work piece machined by the micromachining tool system. The gage comprises a glass plate containing two electrical contacts and supporting a steel ball resting against the contacts. As the element or workpiece is moved against the steel ball, the very slight contact pressure causes an extremely small movement of the steel ball which breaks the electrical circuit between the two contacts. The contour information is supplied to a dedicated computer controlling the mciromachining tool so that the computer knows the contour of the element and the work piece to an accuracy of +- 25 nm. The micromachining tool system with X- and omega-axes is used to machine spherical, aspherical, and irregular surfaces with a maximum contour error of 100 nanometers (nm) and surface waviness of no more than 0.8 nm RMS.

45208 **Beam/seam alignment control for electron beam welding.** Burkhardt, J.H. Jr.; Henry, J.J.; Davenport, C.M. (to Dept. of Energy). US Patent Application 936,458. 24 Aug 1978. 9p.

A dynamic beam/seam alignment control system for electron beam welds utilizing video apparatus is described. The system includes automatic control of workpiece illumination, near infrared illumination of the workpiece to limit the range of illumination and camera sensitivity adjustment, curve fitting of seam position data to obtain an accurate measure of beam/seam alignment, and automatic beam detection and calculation of the threshold beam level from the peak beam level of the preceding video line to locate the beam or seam edges.

45209 **Frost-proof and moisture-proof building foundation.** Spengler, H.M. (to Dept. of Energy). US Patent Application 930,782. 3 Aug 1978. 8p.

An improved concrete building foundation for use in climates where frost zones penetrate the earth formation surrounding the building is described. The foundation is characterized by being essentially impervious to frost and moisture so as to considerably minimize heat loss and moisture damage caused by frost penetration of building foundations. The features of the foundation are achieved by encasing formed thermal insulating sheets within the cast concrete foundation about the entire periphery of the building with the formed sheets extending from a location below the frost line to a location above the surface of the earth formation.

45210 **New type of open coaxial resonator.** Nefedov, E.I.; Rossiiskii, I.M. (Institute of Radio Technology and Electronics, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* 23: No. 8, 594-595(Aug 1978).

Proof is given of the existence in an open coaxial cylindrical resonator of high-Q oscillations with a very rare natural frequency spectrum.

45211 **Proceedings of CAM-I's sixth annual meeting of members.** Arlington, TX; Computer Aided Manufacturing-International, Inc. (1977). 184p. (CONF-7711118—).

From 6. annual meeting of members of the Computer Aided Manufacturing - International, Inc.; Arlington, TX, USA (15 Nov 1977).

These proceedings show the concentration of CAM-I members upon the basic issues of computer-aided design and manufacturing. Geometric modeling, process planning, numerical control, and shop floor control hold the greatest promise for sustaining and improving the productivity of manufacturing enterprises. One contribution to the meeting is abstracted and indexed individually. (RWR)

45212 Present efforts of the geometric modeling project. Blackerby, J. (Y-12 Plant, Oak Ridge, TN). pp 133-135 of Proceedings of CAM-I's sixth annual meeting of members. Arlington, TX; Computer Aided Manufacturing-International, Inc. (1977).

From 6. annual meeting of members of the Computer Aided Manufacturing - International, Inc.; Arlington, TX, USA (15 Nov 1977).

A brief overview is given of the Project's current efforts to provide the manufacturing community whith a satisfactory system design to accommodate a variety of geometric modelers interfaced with a starter set of CAM applications. The Project's current strategy for achieving its objectives has evolved principally from a study and evaluation of the Phase I contract. The Project's subsequent efforts to produce a Phase II contract specification are discussed along with the several areas requiring additional attention and future resolution. These areas are highlighted and include applications interface requirements definitions, continued attention and input to the data base discussion, and project education programs in mathematics and concepts embodied in current modeling technology.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 44953, 45687, 45741

45213 Losses in composite superconductors under nonisothermal conditions. Andrianov, V.V.; Baev, V.P.; V. N. Zenkevich; Mints, R.G.; Rakhmanov, A.L. (Institute of High Temperatures, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 8, 596-598(Aug 1978).

A theoretical and experimental investigation was carried out on the losses of twisted, multifilament, composite superconductors under the influence of a pulsed magnetic field. The important effect of the conditions of specimen cooling on the value of the losses was demonstrated. The relation of the losses to the maximum rate of charge of the magnetic field is shown.

PROTECTIVE STRUCTURES AND EQUIPMENT

45214 (EPA—520/1-78-001A) Protective action evaluation, Part 1. Effectiveness of sheltering as a protective action against nuclear accidents involving gaseous releases. Anno, G.H.; Dore, M.A. (Environmental Protection Agency, Washington, DC (USA). Office of Radiation Programs). Apr 1978. 110p. NTIS.

In an airborne release of radioactive material from a nuclear power plant accident, sheltering of individuals is of importance in emergency protective action planning. An analysis to estimate the effectiveness or benefit that might be derived from sheltering is described. The objective of this effort is the development of sheltering effectiveness information for those responsible for formulating required emergency plans for nuclear power plant siting. Shelter effectiveness is specifically defined as the dose reduction factor (DRF). DRF estimates for different conditions of source release, shelter structure assumptions, and operational time parameters are made for both whole-body and thyroid doses separately, based on a single-compartment structural model of the time-varying outside and inside gaseous radionuclide sources of krypton, zenon, and iodine. Design basis accident (DBA) assumptions are made for the gaseous radionuclide release. The magnitude of the release and dose estimates are based on radionuclide data from The Reactor Safety Study (WASH-1400). Source release time and duration assumptions are related to release categories PWR 1, PWR 3, and PWR 4, for which release times range from 1.5 to 2.5 hr and the release duration ranges from 0.5 to 3 hr. The basic shelter model characteristics considered are gamma ray attentuation, source geometry, gaseous fission-product ingress, and air change rate. Temporal parameters considered are source release time and duration, cloud travel time, and time spent in the shelter structure. Also, the analysis of shelter effectiveness is based on a time-frame model, which can be conveniently related to other operational times important for emergency planning. In addition to developing shelter-effectiveness estimates parametrically, the advantage of exiting and evacuating the vicinity of the shelter area after some initial time in the shelter is analyzed from the standpoint of the DRF and temporal considerations.

HANDLING EQUIPMENT AND PROCEDURES

45215 (UCRL—82754) Nuclear criticality experiments from 1943 to 1978. An annotated bibliography: Volume 1, main listing. Koponen, B.L.; Wilcox, T.P.; Hampel, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 13p. (CONF-790602—46). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

This report only describes the bibliography which contains 1067 citations from the literature of critical and near-critical nuclear experiments. The bibliography provides an up-to-date index to reports containing useful data for many types of criticality studies. Most of the reports can provide specifications for relatively simple critical configurations necessary for validating nuclear constants and calculational techniques. The reports of more than 1143 experimentors at 38 international facilities since 1943 are cross-referenced. This collection contains the prototypes of many different designs of nuclear reactors and studies performed to ensure the safe use of fissile materials in chemical processing plants, storage facilities, and transportation containers. The bibliography has three volumes. Volume 1 contains the main listing of citations with abstracts. Volume 2 is a set of indexes organized by report number, publication date, experimental facility, and author name. Volume 3 provides a subject index, concorded on the significant keyphrases derived from titles, and an index of key terms extracted from titles and abstracts. The bibliography was printed by computer as a selection from a computerized system at Lawrence Livermore Laboratory containing information and data on criticality experiments.

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 44812

45216 (LA-UR—79-430) Finite element model for nonlinear shells of revolution. Cook, W.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-790802—25). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Nuclear material shipping containers have shells of revolution as basic structural components. Analytically modeling the response of these containers to severe accident impact conditions requires a nonlinear shell-of-revolution model that accounts for both geometric and material nonlinearities. Existing models are limited to large displacements, small rotations, and nonlinear materials. The paper presents a finite element model for a nonlinear shell of revolution that will account for large displacements, large strains, large rotations, and nonlinear materials.

45217 (LA-UR—79-1321) Finite element linear models for symmetrically loaded thin shells of revolution. Cook, W.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 25p. (CONF-790811—1). Dep. NTIS, PC A02/MF A01.

From 5. international seminar on computational aspects of the finite element method; Berlin, F.R. Germany (20 Aug 1979).

Four finite element linear models for symmetrically loaded shells of revolution are presented. These models, which were developed for a version of NONSAP used to analyze energy materials shipping containers are: (1) a virtual work model that approximates equilibrium and uses two displacements and meridional rotation for the nodal variables; (2) a mixed model that approximates equilibrium and the meridional bending moment constitutive relation using two displacements and meridional bending moments for the nodal variables; (3) a virtual work model that approximate equilibrium using transverse shear deformation and uses two displacements and meridional rotation as the nodal variables; and (4) a virtual work model that approximates equilibrium. This model includes transverse shear deformation and moments turning about the middle surface normal. The nodal variables are displacements and meridional rotation. These models have both two- and three-node elements and include both reduced and exact numerical integration. Each of these models can adequately predict the stress resultants and bending moments required for analysis of a thin shell of revolution if enough elements are used. Three example problems are discussed: a plate with a shear load, a cylindrical shell with a shear load, and a hemispherical shell with an applied moment. These problems are used to demonstrate the advantages of each model.

MINING AND DRILLING EQUIPMENT AND FACILITIES

45218 Scissor well template. Worrell, J.R.; Berman, M.Y. (to Standard Oil Co.). US Patent 4,147,036. 3 Apr 1979. Filed date 2 Sep 1977. 6p.

The invention discloses a scissored sea-floor well template for positioning spacing of subsea wells or piling in the sea floor. Two arms, each having a pontoon template at each end thereof, are pivotally connected. The two arms are rotated about the pivot to a closed position for transportation to the marine site at which they are to be used. Inasmuch as the template is provided with pontoons, it can be towed and does not have to be loaded on a barge although it could be. Upon reaching the well site the arms are opened so that the pontoon templates assume the desired shape. The arms are then locked in this extended position and the scissor well template is then lowered to the ocean floor.

LASERS

REFER ALSO TO CITATION(S) 45206

45219 (AD-A—059438) **Integral equations and functional methods for laser mode profiles. Final report.** Reichert, J.D.; Kwatra, A. (Texas Tech Univ., Lubbock (USA). Optical Sciences Lab.). 1 Dec 1977. 145p. NTIS PC A07/MF A01.

A new integral equation for optical resonators has been derived from the boundary value problem. This equation, called the Source Integral Equation (SIE), has been solved approximately and mode shapes compared with those from the widely used Fox-Li Integral Equation (FLIE). A double resonance condition (constraints on both mirror separation and transverse dimension) has been obtained from a self-consistency condition. Approximations to the resonance condition have been devised for the limiting case of flat mirrors. The results obtained from a Functional Equation Method (FEM) are compared with traditional computer solutions. The locations of the peaks and valleys agree well and the overall mode shapes are similar. This verifies the utility of the FEM for spherical mirrors of circular aperture. The FLIE and SIE results from the FEM, are compared to confirm the validity of the FEM approach for the SIE. The SIE results are compared to the traditional computer results to find effects of the corrections of the SIE to the FLIE. (Author)

45220 (AD-A—060447) **Optical gain measurements and development studies of visible chemical laser systems. Final report.** Johnson, S.E.; Scott, P.B. (Xonics, Inc., Van Nuys, CA (USA)). 31 Aug 1978. Contract N00173-76-C-0301,. 145p. NTIS PC A07/MF A01.

Chemiluminescence spectra and laser cavity gain measurements have been made on chemical reactions thought to have promise for visible lasing. A shock tunnel apparatus capable of producing hot flows for periods of milliseconds was used for the experiments. Group II metals (magnesium, strontium and calcium) reacted with carbon monoxide and nitrous oxide resulted in bright band chemiluminescence, and low excited state yields. The low yields appear to be due to electronic state quenching. A new ultraviolet band of MgO was observed. Magnesium-fluorine reactions repeated the previously observed abnormal population distributions, but no significant laser gain was observed. Xenon excimer radiation resulting from chemical reaction was observed to be very bright, and possible laser gain was implied by the relative intensities of the output light polarized normal and parallel to the Brewster window axes. Diatomic excited sulfur B-X radiation from chemical reactions was observed in detail, but no gain was observed.

45221 (CONF-761168—(Summ.), pp 38-48) **Material requirements for fusion lasers.** Weiss, J.A. (Department of Energy, Washington, DC). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

Refractive indexes and figure of merit for various solid-state laser materials are presented. (TFD)

45222 (CONF-761168—(Summ.), pp 55-70) **Optical surface and coating requirements for laser systems.** Bennett, H.E. (Michelson Laboratories, Naval Weapons Center, China Lake, CA). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

An analysis is presented that shows that the requirements on optical figure for mirrors and windows used in laser systems are surprisingly severe even in the infrared and become even more demanding for components used in the ultraviolet. If only a small number of components are used in the optical train, however, the demands on optical figure for ultraviolet components do not exceed the state-of-the-art. Only a few mirror substrate materials appear adequate to handle the distortion from a single pulse. Molybdenum is excellent, silicon carbide promises to be an even better choice. To handle the average power in a train of pulses these substrate materials would be used in an internally cooled mirror design. The single pulse distortion, however, is not affected by cooling. The demand on the optical coatings is severe both for infrared and ultraviolet laser applications. Coatings having reflectances of 99.8% in the infrared and 99.5% in the ultraviolet are predicted to be adequate to obtain diffraction limited performance in the examples given. It is concluded that adequate optics for high intensity laser beams will require extensive research and development before they are obtainable routinely. However, successful optical components for both excimer lasers operating in the near ultraviolet and infrared lasers appear to represent an attainable goal.

45223 (CONF-761168—(Summ.), pp 115-136) **Bridging the gap between research and production.** Braunstein, M. (Hughes Research Laboratories, Malibu, CA). Jan 1979.

From ERDA/DPR symposium on thin-film research; Pacific Grove, CA, USA (1 Nov 1976).

The paper presents results achieved for surface finishing and optical coating technology for high energy IR laser window materials. Experimental results on the surface finishing of the windows is presented and optical absorption in potassium chloride and zinc selenide at 10.6 μm is discussed relative to the surface finishing and handling operations. Theoretical designs and experimental results for antireflecting coatings for zinc selenide, potassium chloride, and calcium fluoride are discussed.

45224 (N—78-29436) **System optimization of gasdynamic lasers, computer program user's manual.** Otten, L.J.I.; Saunders, R.C.I.; Morris, S.J. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Apr 1978. 49p. NTIS PC A03/MF A01.

The user's manual for a computer program that performs system optimization of gasdynamic lasers is provided. Detailed input/output formats are CDC 7600/6600 computers using a dialect of FORTRAN. Sample input/output data are provided to verify correct program operation along with a program listing.

45225 (NTIS/PS—78/1326) **Gallium arsenide lasers (a bibliography with abstracts). Report for 1964—Nov 1978.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jan 1979. 180p. NTIS PC N01/MF N01.

The report covers the design, development, and applications of gallium arsenide lasers. Studies on band theory, optical modulators, emission spectra, optical pumping, tuning, and efficiency of these lasers are included. The updated bibliography contains 173 abstracts, 33 of which are new entries to the previous edition.

45226 (PB—287119) **Electron beam controlled gas lasers. Interim report, 15 January 1977—15 January 1978.** DeTemple, T.A. (Illinois Univ., Urbana (USA). Electro-Physics Lab.). Jul 1978. 25p. NTIS PC A02/MF A01.

This report summarizes an experimental and theoretical investigation of Xe laser transitions in high pressure electron beam initiated discharges in Ar-Xe mixtures. The significant experimental features include an overall conversion efficiency of 1.3%, including deposited beam energy, the dominant line being 1.73 micrometers, and an optimum operating pressure of 2.5 atmospheres. The dominant kinetics point towards an energy recirculation from metastable Xe involving dissociated recombination pumping, cascade pumping and possible contributions from direct excitation from levels lower than the upper laser state.

45227 **Observation of fluorescence line narrowing, hole burning, and ion-ion energy transfer in neodymium laser glass.** Brawer, S.A.; Weber, M.J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Appl. Phys. Lett.;* **35**: No. 1, 31-33(1 Jul 1979).

The existence of hole burning and the degree of homogeneity in the $^4F/sub\ 3/2/ \rightarrow {}^4I/sub\ 11/2/$ laser transition of Nd^{3+} in a silicate glass at 295 K are established by exciting the small thermal population in the $^4I/sub\ 11/2/$ state with a pulsed Nd : YAG laser and observing resonant fluorescence line narrowing. Measurements of time-resolved line-narrowed $^4F/sub\ 3/2/ \rightarrow {}^4I/sub\ 9/2/$ spectra show that hole filling is slow; cross relaxation rates between ions in spectrally different sites are $< 10^4\ s^{-1}$ for concentrations of $<$ or $=3$ wt.% Nd_2O_3.

45228 **Role of the III(1/2) -II(1/2) transition in rare-gas—halide kinetics.** Julienne, P.S.; Krauss, M. (Molecular Spectroscopy Division, National Bureau of Standards, Washington, D.C. 20234). *Appl. Phys. Lett.;* **35**: No. 1, 55-57(1 Jul 1979).

Rare-gas—halide spectra have previously been analyzed in terms of the strong III (1/2) -I (1/2) lasing transition and the weaker II (3/2) -I (3/2) broad continuum. However, the III (1/2) -II (1/2) transition is also a broad continuum that strongly overlaps the II(3/2) -I(3/2) transition and has an Einstein coefficient of a similar magnitude. The existence of this transition requires a reinterpretation of previous kinetic data on ArF, KrF, XeF, and XeCl. Simultaneous energy extraction from both the III (1/2) and II(3/2) states should be possible for lasing in the broad continuum.

45229 **Spectroscopic characteristics of an optically pumped carbon tetrafluoride laser.** Averin, V.G.; Alimpiev, S.S.; Baronov, G.S.; Karlov, N.V.; Karchevskii, A.I.; Martsynk'yan, V.L.; Nabiev, S.S.; Sartakov, B.G.; Khokhlov, E.M. (I 4260By). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 527-528(Nov 1978).

The output frequencies of a CF_4 laser were studied as a function of pump frequency from a CO_2 laser. The working pressure was 1-30 torr and the temperature 100—200°K.(AIP)

45230 **Intense pulsed lasing at lines of the P and R branches of the $00^0 2-[10^0 1,02^0 1]/sub\ I,II/$ in a CO_2 TEA laser.** Bertel', I.M.; Kuntsevich, B.F.; Petukhov, V.O.; Stepanov, B.I.; Trushin, S.A.;

Churakov, V.V. (Institute of Physics, Academy of Sciences of the Belorussian SSR, Minsk). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 532-533(Nov 1978).

The time evolution and energy yield at the fundamental and additional bands of a double-discharge CO_2 laser were studied at a total pressure of 1 atm.(AIP)

45231 InGaAsP injection heterojunction laser at 1.3—1.5μ. Alferov, Z.I.; Gorelenok, A.T.; Kolyshkin, V.I.; Kop'ev, P.S.; Tarasov, I.S.; Mdivani, V.N.; Tibilov, V.K.; Usikov, A.S. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 534-535(Nov 1978).

A heterojunction laser that operates at 300°K has been developed through the implantation of oxygen ions. The threshold current density is found to be a new low.(AIP)

45232 Multi-atmospheric halogen compatible cavity. Sze, R.C. (to Dept. of Energy). US Patent Application 934,763. 17 Aug 1978. 7p.

The invention discloses a cavity formed of Teflon to provide extended static fill lifetimes for gases containing halogens. A double cavity configuration provides structural integrity to the inner Teflon cavity by maintaining an identical multi-atmospheric pressure within the outer structural cavity to minimize tension on the Teflon inner cavity. Use of a quantity of the lasing gas in the outer cavity or a constituent of that gas minimizes contamination of the lasing gas.

45233 Investigation of parametric relations for steady-state CO laser. Zhdanok, S.A.; Kochetov, I.V.; Napartovich, A.P.; Novobrantsev, I.V.; Pevgov, V.G.; Starostin, A.N. (Scientific-Research Institute of Nuclear Physics at the M. V. Lomonosov Moscow State University). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 7, 485-487(Jul 1978).

The results of the analytical theory of the steady-state CO laser are compared with numerical solutions to the equations of the multilevel vibrational kinetics. (AIP)

45234 Theory of the photorecombination laser thermally induced behind a shock-wave front. Pekar, A.S.I.; Izmailov, I.A.; Kochelap, V.A.; Kukibnyi, Y.A. (Institute of Semiconductors, Academy of Sciences of the Ukrainian SSR, Kiev). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 7, 488-490(Jul 1978).

One-dimensional calculations are performed to evaluate the feasibility of a photorecombination laser. The difficulties of timing of the thermal reaction are covered in detail. (AIP)

45235 Effects of mixture composition on superequilibrium chemical pumping of the vibrational levels of CO_2 in a CO + N_2O gasdynamic laser. Kovtun, V.V.; Kudryavtsev, N.N.; Novikov, S.S.; Svetlichniy, I.B.; Shagov, P.N. (Institute of Chemical Physics, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 7, 503-504(Jul 1978).

The gain and vibrational temperature of CO_2 were measured in order to determine the efficiency of chemical pumping as functions of He concentration and CO-N_2O balance. (AIP)

45236 InSb laser with two-photon pumping by CO_2 laser radiation. Mylnikov, G.D.; Sobolenko, D.N.; Shcheblykin, Y.V. (I. V. Kurchatov Atomic Energy Institute, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 6, 416-418(Jun 1978).

It is demonstrated that the Raman emission from the optically pumped InSb laser has a threshold dependence on the pump intensity. (AIP)

45237 Method and apparatus for producing laser radiation following two-photon excitation of a gaseous medium. Bischel, W.K.; Jacobs, R.R.; Prosnitz, D.; Rhodes, K.; Kelly, P.J. (to Dept. of Energy). US Patent 4,140,978. 20 Feb 1978. Filed date 29 Apr 1977. 8p.

PAT-APPL-792,280.

The invention discloses a method and apparatus for producing laser radiation by two-photon optical pumping of an atomic or molecular gaseous medium and subsequent lasing action. A population inversion is created as a result of two-photon absorption of the gaseous species. Stark tuning is utilized, if necessary, in order to tune the two-photon transition into exact resonance. In particular, gaseous ammonia (NH_3) or methyl fluoride (CH_3F) is optically pumped by a pair of CO_2 lasers to create a population inversion resulting from simultaneous two-photon excitation of a high-lying vibrational state, and laser radiation is produced by stimulated emission of coherent radiation from the inverted level.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 44560, 44835, 44844, 45302

45238 (LBL—9038) **Interferometric study of mass transfer enchancement by turbulence promoters.** Hanson, K.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 111p. Dep. NTIS, PC A06/MF A01.

Thesis.

The use of small obstacles to thin the downstream mass transfer boundary layer has been investigated with a traveling, dual-beam laser interferometer. Plots of boundary layer thickness as a function of the distance from the leading edge of the electrode were developed to study the effects of obstacle shape, the distance of the obstacle from the electrode surface, and Reynolds number for the purposes of determining the optimum conditions to achieve high mass transfer rates. Parameters which characterize the efficiency of the obstacles, the minimum boundary layer thickness in the wake, and the recovery distance downstream of each obstacle have been introduced to quantitatively describe the results. In addition, the effect of local turbulence near the obstacles on the deposit morphology has been described.

45239 Inertial coupling in dynamic equations of components in a mixture. Chao, B.T.; Sha, W.T.; Soo, S.L. (Argonne National Lab., IL). *Int. J. Multiphase Flow;* **4**: 219-223(1978).

The existence and uniqueness of partition of the inertial coupling terms in the momentum and energy equations of a component in a mixture have been derived when disparate mass velocities and static temperatures exist. Evidences based on one dimensional analyses include reducing to the case of a dilute suspension, exhibiting consistenly hyperbolic nature of both the mixture and the component equations, and giving real characteristics of the system equations.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 44770, 45202

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 44420

45240 (SAND—78-1451C) **Polyalgorithmic approach to multiwire and PC routing.** Wisniewski, J.A.; Bossard, J.R. (Sandia Labs., Albuquerque, NM (USA); Department of Defense, Ft. Meade, MD (USA)). 1979. Contract EY-76-C-04-0789. 16p. (CONF-790626—2). Dep. NTIS, PC A02/MF A01.

From 16. design automation conference; San Diego, CA, USA (25 Jun 1979).

An algorithm for discrete wiring of circuit boards is presented. The method consists of a fast, class router and a Lee algorithm. The method exhibits the run time characteristics of the fast router as well as the routing capabilities associated with Lee's algorithm. The algorithm is shown to be superior to either the class router or the Lee algorithm used alone.

45241 (SAND—79-0972) **IVFOR: a user-oriented program characterizing the current—voltage properties of a two terminal device.** Lyons, G.R.; Wiczer, J.J. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

A user-oriented computer program to measure the dc current—voltage characteristics of a two-terminal semi-conductor device is described. This report contains a complete listing of the necessary computer program steps, an example computer run, and a description of the hardware configuration required to make these measurements. The software reported here is primarily intended for use with BASIC-compatible minicomputers used in automatic or semiautomatic data acquisition systems. 6 figures.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 44270, 44271, 44286, 44287, 44288, 44715

45242 (DOE/CS—5552-T1) **Proposed test standard for rating wood-fired, closed combustion-chamber, heating appliances.** (Auburn Univ., AL (USA). Engineering Experiment Station). 16 Feb 1979. Contract EC-77-S-05-5552. 29p. Dep. NTIS, PC A03/MF A01.

This standard prescribes a method of testing for obtaining heat capacities, efficiencies, and air intake flow rates for the purpose of specifying a standard rating for wood-fired appliances with closed combustion chambers. For the puspose of this standard, wood-fired appliances with a closed fire chamber is one that meets the following requirement: the air-fuel ratio is less than 30 during the burning o

90% or more of the fuel mass consumed in one firing cycle. The purposes of this Standard are to: establish a uniform method of testing for obtaining rating data; specify types of test equipment for performing such tests; specify data required and calculations to be used; and list and define the terms used in testing.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 44567

45243 Riser set-aside system. Ilfrey, W.T.; Heilhecker, J.K.; Maus, L.D. (to Exxon Production Research Co.). US Patent 4,147,221. 3 Apr 1979. Filed date 4 Aug 1977. 18p.

A marine riser system for use in deep water drilling operations from a floating vessel is disclosed. The riser system permits detachment of the lower end of the riser from the wellhead enabling the riser to be set aside to a position which is clear of the wellhead. Support means adjacent the wellhead can be used to support and position the riser when it is set aside. Tensioners, support mechanisms and guidance means are provided to move the riser back and forth between the wellhead and support means. In this manner, casing and tools having diameters larger than that of the riser can be inserted into the wellhead without returning the riser to the surface. Drilling operations with large diameter drill bits can also be conducted with the riser in the set aside position.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 44733, 44935

45244 (PB—287207) Electrostatic effects in fabric filtration. Volume II. Triboelectric measurements and bag performance (annotated data). Final report, September 1973-May 1978. Frederick, E.R. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Jul 1978. 81p. NTIS PC A05/MF A01.

The report describes the construction and application of a bench-scale, single-bag, experimental filter. It also describes several complementary evaluation procedures and their data. Especially significant are the methods for, and results of, electrical determinations that are not normally applied to filter media and particulates. The effect of these electrical parameters on the collection process is used to explain performance variations. Results of several filtration studies on several industrial particulates (e.g., from a power plant, and from metallurgical and chemical processes) are reviewed in detail and explained on the basis of electrostatic properties. Flyash collection, for example, was favored by the use of mid-triboelectric position media and not by the highly electropositive or electronegative fabrics that are used for their high temperature properties. Three different electric furnace dusts tended to respond best (filtrationwise) with mid-triboelectric position fabrics, modified for different cleaning practices. Steel grinding and burning dusts offered very critical filtration characteristics that demanded control of aerosol flow and particulate loading, as well as special care in filter media selection. A ferromolybdenum by-product dust was collected best by very electropositive fabrics.

45245 (PB—288203) Particle collection by a venturi scrubber downstream from an electrostatic precipitator. Final report Jan 1977—Feb 1978. Sparks, L.E.; Ramsey, G.H.; Daniel, B.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). Oct 1978. 34p. NTIS PC A03/MF A01.

The report gives results of pilot plant experiments of particulate collection by a venturi scrubber downstream from an electrostatic precipitator (ESP). The data, covering a range of scrubber operating conditions and ESP efficiencies, show that particle collection by a venturi scrubber is not affected by the upstream ESP; i.e., for a given scrubber pressure drop, particle collection efficiency (as a function of particle diameter) is the same whether the ESP is on or off. The experimental results are in excellent agreement with theoretical predictions. Order of magnitude cost estimates indicate that particle collection by ESP scrubber systems is economically attractive when scrubbers must be used for SO control.

45246 Apparatus and process for the removal of pollutant material from gas streams. Ewan, T.K.; Bass, M.R.; Means, J.D.; Frier, J.L.; Holland, O.L. (to Lone Star Steel Co.). US Patent 4,141,701. 27 Feb 1979. Filed date 1 Nov 1976. 32p.

A process and apparatus is disclosed for the removal of pollutant material including solid or liquid particulate matter and gaseous pollutants from gas streams in which the gas is driven through a mixing tube by forming a jet of a compressible fluid such as steam or air or the whole or a part of the polluted gas itself. In some instances the jet acts as an ejector to induce flow of the polluted gas into the mixing tube but when all of the polluted gas is formed into a jet it is directed into the mixing tube without any ejector action. A mechanically atomized liquid is introduced into the outer region of the jet of compressible fluid emerging from the nozzle in which the jet is formed. The mechanically atomized liquid is further atomized by the shearing action of the jet to form high velocity droplets which are intimately and turbulently mixed with the pollutant-containing gas and retained in the mixing tube for a sufficient time so that the pollutants become entrained with the water droplets. The turbulent mixture is then directed into a diffuser having an increasing cross-sectional area and deflected as it enters the diffuser away from one portion of the interior surface of the diffuser and toward an opposite portion of the interior surface of the diffuser and also decelerated so as to cause a separation in the flow of the liquid and non-liquid constituents of the mixture. Apparatus is disclosed including a compressible fluid nozzle for forming the jet and a liquid injector, a mixing tube, a diffuser, and fluid and mechanical separating means whereby a separate flow of the particulate entrained in liquid droplets is established in the diffuser for removal from the cleaned gas stream. If it is desired to remove reactive gaseous pollutants from a gas stream, appropriate chemical reagents may be added to the injected liquid or directly to the gas stream prior to treatment.

PARTICLE ACCELERATORS

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 45256, 45257

45247 (COO—2114-31) Design of small angle luminosity monitor/two photon tagging detector. Smith, J. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). Jul 1978. Contract EY-76-C-02-2114. 12p. Dep. NTIS, PC A02/MF A01.

A proposed design is presented for a two-photon tagging system as a low angle luminosity monitor at PEP, along with justifying arguments. (GHT)

45248 (LBL—8387) Longitudinal motion in high current ion beams: a self-consistent phase space distribution with an envelope equation. Neuffer, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 5p. (CONF-790327—149). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Many applications of particle acceleration, such as heavy ion fusion, require longitudinal bunching of a high intensity particle beam to extremely high particle currents with correspondingly high space charge forces. This requires a precise analysis of longitudinal motion including stability analysis. Previous papers have treated the longitudinal space charge force as strictly linear, and have not been self-consistent; that is, they have not displayed a phase space distribution consistent with this linear force so that the transport of the phase space distribution could be followed, and departures from linearity could be analyzed. This is unlike the situation for transverse phase space where the Kapchinskij—Vladimirskij (K—V) distribution can be used as the basis of an analysis of transverse motion. In this paper a self-consistent particle distribution in longitudinal phase space is derived which is a solution of the Vlasov equation and an envelope equation for this solution is derived.

45249 (LBL—9068) Proposed orbit and vertical dispersion correction system for PEP. Close, E.; Cornacchia, M.; King, A.S.; Lee, M.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1978. Contract W-7405-ENG-48. 22p. (PEP-NOTE—271; CONF-790327—151). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The proposed arrangement of position monitors and dipole magnets for the closed orbit correction system in PEP is described. The computer code ALIGN, which simulates and corrects closed orbit displacements, has been used to study the most effective layout of monitors and correctors. The vertical dispersion function has been computed before and after closed orbit correction. The results indicate that the residual vertical dispersion after the orbit is corrected could exceed the tolerable values. A correction procedure for the vertical dispersion has been studied with the computer code CO-OP and this scheme of correction has been verified experimentally in SPEAR.

45250 (SLAC-PUB—2273) **Investigation of the flip-flop beam—beam effect in SPEAR.** Donald, M.H.R.; Paterson, J.M. (Stanford Linear Accelerator Center, CA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—84). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

When colliding electron and positron bunches in SPEAR at high values of the beam—beam tune shift parameter $\Delta\nu$, it had been observed that sometimes one of the equal intensity beams would blow up in the vertical plane more than the other beam. It was subsequently found that a small adjustment to the phase difference between the RF accelerating cavities would make the beam flip the other way. The results of the investigation of this phenomenon are presented in this paper.

AUXILIARIES AND COMPONENTS

EXPERIMENTAL FACILITIES AND EQUIPMENT

45251 (AD-A—058003) **A neutrino communications system.** Albers, J.; Kotzer, P. (Western Washington Univ., Bellingham (USA)). 25 Apr 1978. Contract N00014-77-C-0363. 12p. NTIS PC A02/MF A01.

Described in this note are modifications to the Fermilab Accelerator loading and unloading system, a time synchronization system (to provide the necessary common time base) and a receiver which serve as a theoretical model for a workable neutrino communications system. The communications system is based on the fact that protons circulate in thirteen booster batches, each consisting of 84 precisely spaced rf buckets, each bucket one nanosecond wide and 18.83 nanoseconds in spacing. An encoder is proposed to write the information in digital form.

45252 (CONF-790327—131) **Commissioning of the Argonne Intense Pulsed Neutron Source (IPNS-I) accelerator.** Rauchas, A.V.; Brumwell, F.R.; Volk, G.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The IPNS-I 500 MeV Rapid Cycling Synchrotron (RCS) was commissioned during March of 1977. It was originally designed as an injection energy booster for the Zero Gradient Synchrotron (ZGS), as well as a source of high intensity proton beams for neutron production. With the termination of the high intensity operation of the ZGS, the accelerator became a dedicated machine for neutron physics. After a period of tuning and improving accelerator components, the accelerator officially began neutron physics experiments on July 1, 1978. The accelerator has achieved a repetition rate of 15 Hz with beams of 1×10^{12} protons delivered on target. Operation at 30 Hz is expected soon. A description of the accelerator is presented. Turn on procedures, operating experience and initial performance problems are also discussed.

45253 (LBL—8410) **Eight-tesla synchrotron dipoles: design alternatives.** Gilbert, W.S.; Lambertson, G.R.; Meuser, R.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-740-ENG-48. 5p. (CONF-790327—150). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A program to develop accelerator dipoles with significantly enhanced performance, into the 8-tesla range is described. Analytical design studies, based on idealized configurations, have been done to trace the dependence of stresses within the coil and overall magnet size on the magnet aperture, coil current density, central magnetic field, structural ring stress, and magnetic induction in the iron flux-return yoke. The development program includes: (1) development and measurements at 4.2°K of coil structures consistent with the requirements of the analytical design studies; (2) superfluid helium II at 1.8°K and at atmospheric pressure (large magnets as well as conductors will be tested); (3) development and evaluation of aluminum stabilization and various A-15 superconductors; and (4) tests of various model dipoles with instrumentation to measure mechanical motion.

45254 (SLAC-PUB—2292) **Neutron sources and their characteristics.** McCall, R.C.; Swanson, W.P. (Stanford Linear Accelerator Center, CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 12p. (CONF-790467—1). Dep. NTIS, PC A02/MF A01.

From Conference on neutrons from electrons accelerators; Gaithersburg, MD, USA (9 Apr 1979).

The significant sources of photoneutrons within a linear-accelerator treatment head are identified and absolute estimates of neutron production per treatment dose are given for typical components. It is found that the high-Z materials within the treatment head do not significantly alter the neutron fluence but do substantially reduce the average energy of the transmitted spectrum. Reflection of neutrons from the concrete treatment room contribute to the neutron fluence, but not substantially to the patient integral dose, because of a further reduction in average energy. The ratio of maximum fluence to the treatment dose at the same distance is given as a function of electron energy. This ratio rises with energy to an almost constant value of 2.1×10^8 neutrons cm^{-2} rad^{-1} at electron energies above about 25 MeV. Measured data obtained at a variety of accelerator installations are presented and compared with these calculations. Reasons for apparent deviations are suggested. Absolute depth-dose and depth-dose-equivalent distributions for realistic neutron spectra that occur at therapy installations are calculated, and a rapid falloff with depth is found. The ratio of neutron integral absorbed dose to leakage photon absorbed dose is estimated to be 0.04 and 0.2 for 14 to 25 MeV incident electron energy, respectively. Possible reasons are given for lesser neutron production from betatrons than from linear accelerators. Possible ways in which neutron production can be reduced are discussed.

45255 **High-current electron accelerator for optical pumping of gases.** Badalyants, G.R.; Mamikonyan, V.A.; Nersisyan, G.T.; Papanyan, V.O. (Institute of Physical Studies, Academy of Sciences of the Armenian SSR, Ashtarak). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 543-544(Nov 1978).

It was found that largest current density of the electron beam could be achieved by employing a cathode composed of strips of Cn foil sandwiched between layers of fiberglass laminate.(AIP)

STORAGE RINGS

REFER ALSO TO CITATION(S) 45247, 45249

45256 (BNL—25710) **Beam-beam force and storage ring parameters.** Herrera, J.C. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 14p. (CONF-790318—1). Dep. NTIS, PC A02/MF A01.

From Symposium on nonlinear dynamics and the beam-beam interaction; Upton, NY, USA (19 Mar 1979).

The fundamental aspects of the beam—beam force as it occurs in Intersecting Storage Rings are reported. The way in which the effect of the beam—particle electromagnetic force (weak—strong interaction) is different in the case of unbunched proton beams which cross each other at an angle (as in the ISR and in ISABELLE) is shown, as compared to the case of electron—positron beams where bunches collide head-on (as in the Spear II Ring and in PETRA and PEP).

45257 **Effect of polarization on the internal scattering of electrons in storage rings.** Baier, V.I.; Katkov, V.M.; Strakhovenko, V.M. (Nuclear Physics Institute, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 8, 573-575(Aug 1978).

The method of determining beam polarization by the number of particles lost in a storage ring is discussed. It is pointed out that the ratio of the maximum allowable momentum deviation to the energy is very small; allowance must be made for the difference between the electron internal scattering cross section and the Born cross section. (AIP)

INSTRUMENTATION

RADIATION INSTRUMENTATION

45258 (LA-UR—79-1173) **Fast multiwire proportional chamber data encoding system for proton tomography.** Brown, D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-790549—6). Dep. NTIS, PC A02/MF A01.

From Conference on computerized data - acquisition systems in particle and nuclear physics; Santa Fe, NM, USA (14 May 1979).

A data encoding system that rapidly generates the binary address of an active wire in a 512-wire multiwire proportional chamber has been developed. It can accept a second event on a different wire after a deadtime of 130 ns. The system incorporates preprocessing of the wire data to reject events that would require more than one wire address. It also includes a first-in, first-out memory to buffer the data flow.

45259 (SAND—79-8218) **Tritium-caused background currents in electron multipliers.** Malinowski, M.E. (Sandia Labs., Livermore,

CA (USA)). May 1979. Contract EY-76-C-04-0789. 23p. Dep. NTIS, PC A02/MF A01.

One channel electron multiplier (Galileo No. 4501) and one 14 stage Be/Cu multiplier (Dumont No. SPM3) were exposed to tritium pressures between ~ 10^{-7} Torr to 10^{-3} Torr in amounts from ~ 10^{-5} Torr-s to 60 Torr-s and the β-decay caused currents in the multipliers measured. The background currents in both multipliers consisted of two components: (1) a high, reversible current which was proportional to the tritium exposure pressure; and (2) a lower, irreversible background current which increased with increasing cumulative tritium exposure. The β-decay caused currents in each multiplier increased the same way with exposure, suggesting the detected electrons arose from decaying tritium adsorbed on surfaced external to the multipliers.

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 44404, 44806, 45272, 45275, 45439

45260 (AD-A—057786) **Silicon detector compensation by nuclear transmutation. Final technical report, 30 June 1976—31 July 1977.** Meese, J.M. (Missouri Univ., Columbia (USA). Research Reactor Facility). Feb 1978. Contract F33615-76-C-5230. 175p. NTIS PC A08/MF A01.

The effects of nuclear transmutation doping in high quality detector grade silicon have been studied. A theoretical treatment of the variations of electrical parameters with fluence and the experimental isochronal annealings of float zone Si, transmutation doped are presented. It is found that several annealing stages observed previously only in Czochralski Si are also observed in this lightly compensated float zone Si. A large concentration of acceptors is produced as a result of thermal irradiation and annealing to 500 C. This concentration is independent of fluence and appears to be related to residual Si impurities previously undetected by electrical, optical or neutron activation analysis experiments. Defect decoration of oxygen or carbon impurities is believed to be the source of these acceptors. Techniques have been devised to produce very high resistivities as a result of high precision nuclear transmutation compensation in nominally undoped material.

45261 (LBL—8139) **Two-dimensional position sensitive Si(Li) detector.** Walton, J.T.; Hubbard, G.S.; Haller, E.E.; Sommer, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 12p. (CONF-781033—42). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Washington, DC, USA (18 Oct 1978).

Circular, large-area two-dimensional Si(Li) position sensitive detectors have been fabricated. The detectors employ a thin lithium-diffused n^+ resisitive layer for one contact and a boron implanted p^+ resistive layer for the second contact. A position resolution of the order of 100 μm is indicated.

45262 (PNL—2807, pp 103-108) **Neutron measurements near PWR power reactors.** Bricka, M. (CEN, Cadarache, France). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

For neutron measurements near PWR power reactors, devices have been developed with a view to the problem of work inside the reactor building, where doses up to 10 rems per hour can be found in some places. Detectors and data processing for these applications are discussed.

45263 **Directional detector of gamma rays.** Cox, S.A.; Levert, F.E. (to Dept. of Energy). US Patent 4,136,282. 23 Jan 1979. Filed date 29 Nov 1977. 4p.

PAT-APPL-855,637.

A directional detector of gamma rays comprises a strip of an electrical conductor of high atomic number backed with a strip of a second electrical conductor of low atomic number. These elements are enclosed within an electrical conductor that establishes an electrical ground, maintains a vacuum enclosure and screens out low-energy gamma rays. The detector exhibits a directional sensitivity marked by an increased output in the favored direction by a factor of ten over the output in the unfavored direction.

RADIATION DOSEMETERS

45264 (PNL—2807) **Seventh DOE workshop on personnel neutron dosimetry.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 158p. (CONF-7810131—). Dep. NTIS, PC A08/MF A01.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Separate abstracts were prepared for the individual papers presented at the meeting.

45265 (PNL—2807, pp 7-11) **Thermoluminescent neutron dosimeter with internal energy: response correction.** Crain, S.L.; Anderson, M.E. (Mound Facility, Miamisburg, OH). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

A thermoluminescent neutron dosimeter containing to cadmium-shielded ^{6}LiF chips is described. The dosimeter also included a ^{7}LiF chip with each of the ^{6}LiF chips to correct for photon rsponse. The calibration of this instrument is discussed.

45266 (PNL—2807, pp 12-16) **Personnel neutron dosimeter for use in a plutonium processing plant.** Brunskill, R.T.; Hwang, F.S.W. (British Nuclear Fuels Ltd., Windscale, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

A thermoluminesence dosimeter for personnel neutron dose measurement, which is based on the albedo principle, has been developed at Windscale works. The dosimeter has been calibrated against a ^{238}Pu/Be neutron source using different degrees of moderation and against a variety of neutron spectra prevailing in different areas of the Plutonium Finishing Plant. The dosimeter consists of two identical parts in which the sensitive elements are graphite discs which have thermoluminescent crystals sealed to the plane faces with a high temperature resin. The graphite discs are supported in teflon washers which fit into a body of tufnol. A circular insert of boronated polythene in each tufnol body provides a thermal neutron absorber for the sensitive element in the other half of the dosimeter. Natural lithium borate was used as the neutron sensitive phosphor and a lithium borate made from isotopes ^{7}Li (99.9%) and ^{11}B (99.2%) as the neutron insensitive materials. Neutron-sensitive lithium borate is sealed to one face of each disc and the neutron-insensitive material to the opposite face. The dosimeter is so assembled that the neutron-sensitive faces both lie in the central plane. The design is such that one neutron sensitive face responds to the incident flux of neutron only while the other responds to the albedo flux.

45267 (PNL—2807, pp 25-37) **Role of an analyzer type albedo dosimeter in routine monitoring and the current situation for the calibration technique.** Piesch, E.; Burgkhardt, B. (Karlsruhe Nuclear Research Centre, Germany). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

This paper summarizes work performed with the Karlsruhe albedo dosimeter and discusses in detail the actual status in albedo dosimetry of: (1) the technique and problems of field calibration; (2) the method of field interpretation with the albedo dosimeter; (3) the influence of persons moving in inhomogeneous stray radiation fields with an extreme change of E/sub eff/; (4) the error of neutron dose estimation due to γ-contributions found under different field conditions; and (5) the application in routine monitoring.

45268 (PNL—2807, pp 38-45) **Albedo-neutron dosimetry studies at Lawrence Livermore Laboratory.** Hankins, D.E. (Univ. of California, Livermore). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

This report summarizes studies performed since the last Workshop meeting. The studies have been divided into four sections: (1) the relative response of Hankins-type albedo-neutron dosimeters made of cadmium and boron; (2) the effect of distance from the body on the response of albedo-neutron dosimeters; (3) the use of the ratio of the top-to-bottom TLDs to determine the calibration factor for albedo-neutron dosimeters; (4) neutron survey at a power reactor and at a neutron radiography facility.

45269 (PNL—2807, pp 46-48) **Personnel neutron monitoring at the NRPB.** Bartlett, D.T. (AERE, Harwell, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

All current methods of personnel neutron dosimetry have limitations as to their application. One must therefore choose that system which best suits ones needs. At present, the choice of the NRPB for its personnel Neutron Monitoring Service is a dosimeter based on Eastman—Kodak NTA nuclear emulsion. The introduction of a modified holder is being considered. This holder has a boron loaded plastic filter between the emulsion and wearer to absorb albedo thermal neutrons. The response of the dosimeter to incident thermal neutrons now approximates its fast neutron response (in terms of tracks mm^{-2} Sv^{-1}) enabling an assessment of the total contribution to total dose equivalent from fast and thermal neutrons. A summary of the relative response of the dosimeter in different radiation fields is given.

45270 (PNL—2807, pp 49-55) **Use of plastic track-detectors for fast neutron dosimetry.** Durrani, S.A. (Univ. of Birmingham, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

The relative efficiencies of a number of plastic track detectors have been measured for revealing recoil-product tracks induced by fast neutrons (14.7 MeV). A more detailed energy-dependent calibration has been carried out for the CA8015 cellulose nitrate plastic. Some methods of automatic/semi-automatic scanning of etched tracks are described. Some recent developments in the electrochemical etching of tracks are reported.

45271 (PNL—2807, pp 67-70) **AERE neptunium dosimeter.** Harrison, K.G. (AERE, Harwell, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

The dosimeter is based on the well-known principle which uses a neptunium fission-foil and a thin polycarbonate track detector. The track detector is etched in hot caustic alkali and the fission-fragment tracks counted using a semi-automatic spark counter. An exploded view of the dosimeter is given along with a description of the dosimeter, processing techniques and the spark counter.

45272 (PNL—2807, pp 71-78) **Improvements of the electrochemical etching technique for fast neutron dosimetry.** Hassib, G.M.; Piesch, E. (Karlsruhe Nuclear Research Centre, Germany). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Amplification of neutron-induced recoil tracks in polycarbonates by the electro-chemical etching techniques has not yet applied in large-scale practical use owing to the large number of parameters affecting the detector response. In order to provide a more reliable ECE for practical neutron dosimetry, investigations to optimize some of the most important parameters were performed. The characteristics of ECE have been studied as a function of frequency from 50 to 1000 Hz, applied voltage up to 2 kV effective and neutron energy and directional dependence. A method to lower the background level is presented which improves also the reproducibility of the measurement.

45273 (PNL—2807, pp 79-80) **Approach to a personnel neutron monitor based on a nuclear track detector.** Hoefert, M. (European Organization for Nuclear Research, Geneva, Switzerland). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Personnel neutron monitoring around high energy proton accelerators has to cope with the extended spectral range of the radiation fields present. The approach to a personnel neutron monitor at CERN is based on the LR115 foil, a layer of 12 μm of red-coloured cellulose nitrate on an inert polyester base. Three different non-radioactive radiators are in contact with the sensitive surface: a layer of 5 μm of boron evaporated on a glass support and shielded by 0.5 mm of cadmium, the same radiator without cadmium shield, and finally the body of the cassette itself made of polycarbonate plastic containing the foil. The system was calibrated both in the stray field around the CERN proton accelerators by comparing the results with neutron dose-rate measurements (field calibration), and with Pu—Be neutrons. While a formula could be found to relate the reading behind the cadmium covered boron radiator and the polycarbonate radiator to dose equivalent over an extended neutron energy range, the one sigma uncertainty for a dose of 100 mrem exceeds 80% for a soft neutron spectrum but stays within 30% for a dose of 300 mrem over the whole energy range.

45274 (PNL—2807, pp 82-88) **Some data on neutron dosimetry research and development at the Atomic Energy Organization of Iran.** Sohrabi, M. (Atomic Energy Organization of Iran, Tehran). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Radiation dosimetry research and development especially for neutrons has been limited in Iran. Due to a rapid growth in nuclear technology programs in this country, a radiation dosimetry program has been underway to fulfill the radiation dosimetry needs. This paper reports a summary of some data on neutron dosimetry research and development at the Atomic Energy Organization of Iran.

45275 (PNL—2807, pp 89-100) **Further investigations on electrochemical etching for personnel neutron dosimetry.** Tommasino, L; Zapparoli, G. (Laboratorio di Dosimetria e Biofisica delle Radiazioni, Rome, Italy). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

The successful applications of electrochemical etching (hereafter ECE) in personnel neutron dosimetry prompted a variety of investigations on this type of etching in different laboratories. Work carried out in our own establishment concerning the development of this technique for the registration of damage tracks is described.

45276 (PNL—2807, pp 101-102) **Lyoluminescence.** Bartlett, D.T. (AERE, Harwell, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Lyoluminescence is the light emitted when irradiated solid substances are dissolved. A large range of organic materials exhibit lyoluminescence, among the more sensitive of which are monosaccharides and amino acids. A dose response curve for mannose ($C_6H_{12}O_6$) and an example of lyoluminescence apparatus are illustrated. The principle advantage of lyoluminescence dosimetry is that lyoluminescent phosphors may be used which closely approximate the chemical composition of tissue. Therefore all radiation fields KERMA in the phosphor approximates KERMA in tissue, and by design of dosimeter there will be a similar correspondence for absorbed dose. There are indications that the light conversion efficiency of lyoluminescent phosphors is not as dependent on LET as observed for thermoluminescent phosphors, and the possibility exists therefore, of an approximate tissue equivalent response in neutron and mixed radiation fields.

45277 (PNL—2807, pp 109-114) **Harwell neutron dosimetry system.** Gibson, J.A.B. (AERE, Harwell, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

The essential feature of the design is to provide an integrated system in which all the parts are used to obtain the best possible assessment of the neutron dose to personnel handling fissionable and α-active nuclear materials. The system is part of the overall dosimetry strategy which includes γ-ray dosimeters, air samplers and management procedures to deal with doses in excess of agreed reference levels based upon ICRP recommendations (ICRP 1977). The neutron dosimetry system is designed to work in controlled areas where the neutron dose equivalent rate exceeds 0.25 mrem/hr (2.5 μSv/hr). For convenience the system may be divided into five major parts: (1) personnel dosimeters for record purposes over periods up to 1 month, i.e., ^{237}Np fission (Harrison et al., 1978) and CEGB albedo (Harvey et al., 1973) dosimeters mounted on a belt; (2) pocket alarm neutron dosimeters to provide a warning when a dose limit is reached and to give the integrated dose over periods up to 16 hr, i.e., a low pressure proportional counter with a thermal neutron response (AERE type 0934); (3) survey instruments, i.e., the Leake counter (AERE type 0075) with a sphere size of 208 mm and a Boot counter (Boot and Gibson, 1978) with a sphere size of 63 mm. The Leake counter gives the total dose equivalent rate and the Boot counter gives the dose equivalent rate for neutrons with energy less than 10 keV which corresponds to the response of the albedo dosimeter; (4) installed instruements based upon the Leak counter; and (5) neutron spectrometry techniques (Banner spheres and ^3He detectors.

45278 (PNL—2807, pp 115-118) **Recent developments in the neutron dosimetry field at Berkeley Nuclear Laboratories.** Harvey, J.R. (Central Electricity Generating Board, Berkeley, England). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Research in neutron dosimetry in the intermediate energy range is reviewed.

45279 (PNL—2807, pp 119-124) **Personnel neutron dosimetry at Riso National Laboratory.** Majborn, B. (Riso National Lab., Roskilde, Denmark). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

Highlights of personnel neutron dosimetry at Risoe National Laboratory are described. Research and development work has been concentrated on thermoluminescence dosimetry but several other types of dosimeters are currently in use.

45280 (PNL—2807, pp 125-127) **Spherical particle neutron dosimeter (SPAN-dosimeter).** Lautenbach, G. (Netherlands Energy Research Foundation, Petten,). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

A new concept for a fast neutron dosimeter is described. The spherical particle neutron dosimeter (SPAN-dosimeter) is based on the well-known track etching technique. However, the detecting

method of a chemically enlarged damage track differs completely from the known techniques as optical registration, spark counting, electrochemical etching. The SPAN-dosimeter consists of a capsule (box) which contains a great number N of small spherical particles ($N = 10^4$ to 10^8). The mean diameter of the spherical particles may be of the order of 0.4 mm. Each spherical is made of a substance A (still to be defined) which is covered by a thin (10μm) spherical shell of a neutron sensitive polymer (CN or polycarbonate). The particles may be embedded in a protective easy solvable matrix. After the exposure of the SPAN-dosimeter to fast neutrons the spherical particles are chemically etched, all at a time, up to the point where the polymer coating of the particles with a recoil track are locally dissolved, so that the material A can react with the etchant or with another active solution. The advantages of this type of dosimeter are discussed.

45281 (PNL—2807, pp 128-133) **Personnel monitoring of neutrons using albedo thermal luminescent dosimeters.** Ryan, R.M. (Rensselaer Polytechnic Inst., Troy, NY). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

During normal operations at commercial nuclear power plants personnel exposure to neutrons is low in relation to the gamma exposure. This is mainly due to the confinement of the neutrons in the containment housing the power plant nuclear steam supply system and minimal access of personnel into this containment. The sources of the neutrons are varied. Three of the sources are associated with the fission process and the other with neutron sources used for instrument calibration. From the fission process we encountered prompt neutrons, delayed neutrons, and neutrons emanating from transuranics manufactured as a by-product of the fission process. The preponderance of these neutrons are less than 10 MeV in energy. Measurements were made at three reactor sites to determine the number and spectral distribution of neutrons and their conversion to dose equivalence. The response of personnel monitoring badges during these measurements were correlated to the measured dose equivalence. The results are reported.

45282 (PNL—2807, pp 134-135) **NBS reference neutron fields for personnel dosimetry calibration.** Schwartz, R.B. (National Bureau of Standards, Washington, DC). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

The US National Bureau of Standards (NBS) has established and characterized several neutron fields for dosimeter calibration. Two of these fields are continuous neutron spectra: the spontaneous fission neutron distribution from ^{252}Cf, and a thermal Maxwellian beam. There are also three monoenergetic reactor beams, with energies of 2, 24, and 144 keV. In addition, monoenergetic beams from the Van de Graaff accelerator are available at energies from 100 keV to 1.5 MeV. The use of these facilities is discussed.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

45283 (PNL—2807, pp 17-24) **Leakage neutron spectrum measurements with the PPN-spectrometer (ECH-Petten).** Lautenbach, G. (Netherlands Energy Research Foundation, Petten). 1978.

From 7. DOE workshop on personnel neutron dosimetry; London, UK (23 Oct 1978).

A prototype Parallel Plate Neutron spectrometer based on neutron moderation was built in 1975 at EGN Petten in order to investigate leakage neutron spectra at (shielded) nn-sources and nn-beams in laboratory areas. The PPN-spectrometer consists of 27 polythene plates (22 x 22 x 1 cm^3) which are vertically inserted into a near cubical box also made of polythene. The box is lined at the inner side with a 1 cm thick layer of boron-plastic material except at the front side (source side). The total dimension of the PPN-spectrometer is 30 x 30 x 26 cm^3. A small BF-counter fits into a vertical slit of one of the polythene moderator plates (the detector plate) which can be inserted at any position between the other vertical plates. Some experiments with the spectrometer are described.

HIGH ENERGY PHYSICS INSTRUMENTATION

45284 (N—78-34025) **Experiment definition and integration study for the accommodation of giant, passive detector of exotic particles in the cosmic rays (epic) payload on shuttle/spacelab missions. Final report, 6 jun. 1977 - 5 feb. 1978.** Price, P.B. (California Univ., Berkeley (USA). Space Sciences Lab.). 1 Jun 1978. Contract NAS5-24166. 74p. NTIS PC A04/MF A01.

The feasibility of the design, construction, launch and retrieval of a hinged 15 ft by 110 ft platform, containing an array of interleaved CR-39 and Lexan track-recording detectors to be placed into circular orbit by space shuttle, is assessed. The total weight of the detector assembly plus supporting structure and accessories is 32,000 pounds. The modular construction permits as little as one fourth of the payload to be exposed at one time. The CR-39 detector has sensitivity adequate to detect and study cosmic rays ranging from minimum ionizing iron-group nuclei to the heaviest elements. The detectors will survive a one year exposure to trapped protons without losing their high resolution. Advantages include low cost, huge collecting power (approximately 150 sq m) as well as the high resolution previously attainable only with electronic detectors.

45285 (N—78-34026) **Observability of the neutrino flux from the inner region of the galactic disk.** Silberberg, R.; Shapiro, M.M.; Stecker, F.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Oct 1978. 6p. NTIS PC A02/MF A01.

The observability of galactic neutrinos in a detector of 10 billion tons of water with an observing time of a few years is explored. Although the atmospheric flux exceeds the galactic flux considerably at energies greater than or equal to 1 TeV, the latter may still provide a marginally observable signal owing to its directionality. Galactic muon neutrinos with energy greater than or equal to 1 TeV will produce a signal approximately 2 sigma above the atmospheric background over a four year period. If electron neutrinos can also be studied with the deep underwater muon and neutrino detector, then galactic electron neutrinos above 1 TeV would give an approximate 4 to 5 sigma signal above the electron neutrino background over a four year integration time.

45286 **Right/left assignment in drift chambers and proportional multiwire chambers (PWC'S) using induced signals.** Walenta, A.H. (to Dept. of Energy). US Patent Application 904,678. 10 May 1978. 11p.

An improved multiwire chamber having means for resolving the left/right ambiguity in the location of an ionizing event is described. The chamber includes a plurality of spaced parallel anode wires positioned between spaced planar cathodes. Associated with each of the anode wires are a pair of localizing wires, one positioned on either side of the anode wire. The localizing wires are connected to a differential amplifier whose output polarity is determined by whether the ionizing event occurs to the right or left of the anode wire.

RADIOMETRIC INSTRUMENTS

45287 (PB—284706) **Nuclear cement content gage comparison analysis. Final report.** Shah, S.C.; Melancon, J.L. (Louisiana Dept. of Transportation and Development, Baton Rouge (USA). Office of Highways). Aug 1977. Contract DOT-FH-11-8852. 64p. NTIS PC A04/MF A01.

The study is concerned with the laboratory evaluation of two prototypes of a nuclear gage for measuring the cement content of plastic concrete. The dependence of the gages' responses on aggregate type and proportions, cement content, and temperature were studied. Analysis of variance and other statistical procedures showed that: (1) the sensitivity and accuracy of the gages is greatly affected by the type of aggregate; (2) the accuracy of the gages for siliceous aggregate mixes was better than twice that for calcareous aggregate mixes; (3) separate calibration curves will have to be generated whenever changes in proportion of chemically-different coarse to fine aggregate occur and, unless suitable electronic compensation can be introduced into future instruments, whenever temperature variations are encountered.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

REFER ALSO TO CITATION(S) 44420

45288 (AD-A—059494) **Dynamic properties of interface states in MOS-structures. Final technical report, 1 January—31 December 1977.** Goetzberger, A.; Klausmann, E.; Schulz, M.J. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Freiburg im Breisgau (Germany, F.R.). Inst. fuer Angewandte Festkoerperphysik). Apr 1978. 35p. NTIS PC A03/MF A01.

The dynamic properties of impurities implanted into the interface of MOS structures are investigated. Interface state density, trapping time constants and capture cross sections are measured. Capacitance and conductance measurement techniques are used. Special consideration is placed on the DLTS (Deep Level Transient Spectroscopy) -method. This method was applied to MOS structures for the first time. The interface state density of implanted MOST structures shows a continuous distribution versus energy. The increase to the band edge is steeper and more distinct in implanted structures than in clean (non-implanted) samples. The capture cross

section drops towards the band edge independent of the implanted species. Its magnitude is always of the same order as in clean samples. Influences of radiation damage can clearly be observed and separated from the continuous interface state spectrum. (Author)

45289 (AD-A—060435) **Electromagnetic pulse (EMP) handbook for Air Force communications service communications-electronics-meteorological engineers. Technical report.** Zych, J.F. (Electronics Engineering Group (1842nd), Scott AFB, IL (USA)). 1 Nov 1976. 78p. NTIS PC A05/MF A01.

This document is to provide basic engineering information about EMP. Emphasis in this document will be on EMP protection guidelines. Information presented is designed to assist engineers in familiarizing themselves with EMP and EMP Problems.

45290 (AD-A—060629) **Emp, lightning, and power transients: their threat and relevance to emp protection standards for telecommunication facilities. Technical information bulletin.** Bodson, D. (National Communications Systems, Washington, DC (USA)). Aug 1978. 38p. NTIS PC A03/MF A01.

The electromagnetic pulse (EMP) is a phenomena created by nuclear explosions. It is a transient electromagnetic wave produced by exoatmospheric, atmospheric, and surface bursts and is characterized chiefly by its short duration, high intensity field. This electromagnetic field can cause severe disruption and possible damage to communications equipment. The most serious EMP threat is that from an exoatmospheric or high altitude burst which potentially can illuminate a large fraction of a communications network and simultaneously disrupt or damage communication equipment over a wide geographical user service area. It is EMP from the high altitude burst that is emphasized since the EMP, blast, radiation, and thermal effects of atmospheric and surface bursts are only significant in negating geographically small communication functions. Lightning and Power line energy surges are discussed. The published surge characteristics for the time domain are provided and the energy threat defined for equipment connected to cable conductor interfaces.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 44750, 44853, 45207, 45412, 45431

45291 (AD-A—059476) **Pulse (photon) counting. I. Determination of optimum measurement system parameters. Technical report.** Darland, E.J.; Leroi, G.E.; Enke, C.G. (Michigan State Univ., East Lansing (USA). Dept. of Chemistry). 4 Jul 1978. Contract N00014-76-C-0434. 32p. NTIS PC A03/MF A01.

Linearity measurements and integral pulse height distributions have been used to evaluate the effects of electron multiplier voltage and discriminator coefficient (Ad) on the stability, sensitivity and dynamic range of three pulse counting (PC) measurement systems. The data show that selection of the highest possible voltage has significant advantages for most experiments, but that the choice of an 'optimum' value for Ad depends on the requirements of the particular experiment and requires careful evaluation of the trade-offs among stability, sensitivity, and dynamic range. Semiquantitative evaluation of these trade-offs on the basis of the experimental results is illustrated. The data also show clearly that measurements such as those reported here must be made on each system, since specific results for one system can not be generalized to others. (Author)

45292 (BDX—613-1198(Rev.)) **Electron microprobe analysis of tantalum—nitride thin films.** Stoltz, D.L.; Starkey, J.P. (Bendix Corp., Kansas City, MO (USA)). Jun 1979. Contract EY-76-C-04-0613. 18p. Dep. NTIS, PC A02/MF A01.

Quantitative chemical analysis of 500- and 2000-angstrom tantalum—nitride films on glass substrates has been accomplished using an electron microprobe x-ray analyzer. In order to achieve this analysis, modifications to the microprobe were necessary. A description of the calibration procedure, the method of analysis, and the quantitative results are discussed.

45293 (CONF-790418—6) **Optimization of an analytical electron microscope for x-ray microanalysis: instrumental problems.** Bentley, J.; Zaluzec, N.J.; Kenik, E.A.; Carpenter, R.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From Scanning electron microscopy conference; Washington, DC, USA (16 Apr 1979).

The addition of an energy dispersive x-ray spectrometer to a modern transmission or scanning transmission electron microscope can provide a powerful tool in the characterization of the materials. Unfortunately this seemingly simple modification can lead to a host of instrumental problems with respect to the accuracy, validity, and quality of the recorded information. This tutorial reviews the complications which can arise in performing x-ray microanalysis in current analytical electron microscopes. The first topic treated in depth is fluorescence by uncollimated radiation. The source, distinguishing characteristics, effects on quantitative analysis and schemes for elimination or minimization as applicable to TEM/STEMs, D-STEMs and HVEMs are discussed. The local specimen environment is considered in the second major section where again detrimental effects on quantitative analysis and remedial procedures, particularly the use of low-background specimen holers, are highlighted. Finally, the detrimental aspects of specimen contamination, insofar as they affect x-ray microanalysis, are discussed. It is concluded that if the described preventive measures are implemented, reliable quantitative analysis is possible.

45294 (CONF-790454—3) **CAMAC as an interface for small laboratory minicomputer systems.** Tippie, J.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From DECUS spring mini/midi symposium; New Orleans, LA, USA (17 Apr 1979).

CAMAC is well suited as an interface for small, general-purpose laboratory data acquisition and control systems. CAMAC has been extensively employed for data acquisition and control in large, high-throughput systems, and a wide selection of CAMAC modules exists from many vendors. For small systems (e.g., PDP-11V03 or small PDP-11/34 systems) CAMAC offers great flexibility with reasonably high throughput. The initial hardware investment to put CAMAC on a system includes a crate and dedicated crate controller. The advantage that CAMAC offers over other alternatives is the wide selection of commercially available modules. In the changing laboratory environment its flexibility and modularity are important assets. 2 figures.

45295 (CONF-790635—2) **Thermocouple error analysis in the design of large engineering experiments.** Anderson, R.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 50p. Dep. NTIS, PC A03/MF A01.

From 10. transducer workshop; Colorado Springs, CO, USA (12 Jun 1979).

The potential errors in temperature measurements employing small diameter (0.5 mm) metal sheathed thermocouples were analyzed for the Core Flow Test Loop experiments at ORNL. The sources of error considered were extension lead wires, reference junctions, the data acquisition system, calibration and decalibration of the sensors, thermal shunting, electrical shunting, electrical leakage, and electrical noise.

45296 (COO—1248-57) **Tandem differential mobility analyzer applied to studies on particle growth and gas phase titration. Final report.** McMurry, P.H.; Liu, B.Y.H. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). Dec 1978. Contract EY-76-S-02-1248. 83p. Dep. NTIS, PC A05/MF A01.

The report deals with the tandem differential mobility analyzer (previously called the aerosol mobility chromatograph) and its application to studies on particle growth and gas phase titration.

45297 (COO—3158-68) **Differentially-pumped low-energy ion-beam system for an ultra-high vacuum (uhv) atom-probe field-ion microscope. Report No. 4017.** Amano, J.; Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Dec 1978. Contract EY-76-S-02-3158. 18p. Dep. NTIS, PC A02/MF A01.

A differentially-pumped low-energy (50 to 3000 eV) ion-beam system for the in-situ irradiation of specimens in an uhv atom-probe field-ion microscope (FIM) was designed and constructed. The ion-beam system consists of a Finkelstein-type ion-source, an Einzel lens and a magnetic mass-aanalyzer. The ion source is connected to the analyzer chamber by small apertures which results in differential pumping between the ion source and the nalyzer chamber; during a typical in-situ irradiation of a specimen the pressure in the atom-probe is $\sim 10^{-7}$ Torr. The ion-current density is $\sim 0.5\ \mu A\ cm^{-2}$ for 300 eV $(He^4)^+$ ions at the atom-probe FIM specimen; ion current-densities as high as (2 to 3) mA cm^{-2} have been achieved for an ion-beam energy ≥ 1 keV. Therefore the irradiation of a specimen with a single-mass, mono-energetic ion-beam is accomplished with the complete elimination of a long pump-down time after the irradiation.

45298 (LA—7642-PR) **Electronic identification. Progress report, October 1, 1977—September 30, 1978.** Holm, D.M.; Seawright, G.L.; Sanders, W.M.; Bobbett, R.E.; Landt, J.A.; Koelle, A.R. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 23p. Dep. NTIS, PC A02/MF A01.

The electronic identification project has been set back because commercial vendors for equipment have not built equipment believed necessary for the National System of the National Livestock Electronic Identification Board. However, a request for quotation for equipment that will satisfy most of the specifications for a National System has been distributed and procurement is anticipated in FY 1979. Significant technical improvements have been made to

increase the range of interrogator receivers and decrease the size. Biological experiments performed at National Veterinary Services Laborotories (NVSL) have demonstrated some of the beneficial effects that temperature monitoring will provide.

45299 (LBL—8129) **Optical timing receiver for the NASA Spaceborne Ranging System. Part II. High precision event-timing digitizer.** Leskovar, B.; Turko, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

The report describes the design of a high precision event-timing digitizer. The event-timing digitizer is basically a combination of the very accurate high resolution real time digital clock and an interval timer. Typically, the digitizer measures the time difference between a pair of start—stop events. The digitizer is started at the beginning each mission and like a clock, counts the time in a range of up to 131 days in 19.5 ps increments. The start pulse is generated each time the laser is fired and fed to one of the event inputs of the digitizer. The time between the leading edge of an event and the mission start pulse is digitized in a time shorter than 5.3 μs and stored in the digitizer's buffer register.

45300 (LBL—8134) **Germanium field-effect transistor made from a high-purity substrate.** Hansen, W.L.; Goulding, F.S.; Haller, E.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 19p. (CONF-781033—44). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Washington, DC, USA (18 Oct 1978).

Field effect transistors have been fabricated on high-purity germanium substrates using low-temperature technology. The aim of this work is to preserve the low density of trapping centers in high-quality starting material by low-temperature (< 350°C) processing. The use of germanium promises to eliminate some of the traps which cause generation-recombination noise in silicon field-effect transistors (FET's) at low temperatures. Typically, the transconductance (g/sub m/) in the germanium FET's is 10 mA/V and the gate leakage can be less than 10^{-12} A. Present devices exhibit a large 1/f noise component and most of this noise must be eliminated if they are to be competitive with silicon FET's commonly used in high-resolution nuclear spectrometers.

45301 (LBL—8884) **Donner 280-Crystal High Resolution Positron Tomograph.** Derenzo, S.E.; Budinger, T.F.; Cahoon, J.L.; Greenberg, W.L.; Huesman, R.H.; Vuletich, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 6p. (CONF-790148—1). Dep. NTIS, PC A02/MF A01.

From IEEE workshop on physics and engineering in computerized tomography; Newport Beach, CA, USA (17 Jan 1979).

We describe a stationary positron tomograph designed for the rapid, accurate, three-dimensional imaging of positron-labeled compounds anywhere in the human body. The system consists of a large gantry containing lead shielding and a 92 cm diam ring of 280 closely-packed rectangular NaI(Tl) crystals, lightpipes and phototubes; coincidence and address circuits; semiconductor histogram memory; a hard-wired reconstructor; and a gray-level CRT. Event rates, backgrounds and resolution test images are presented.

45302 (PB—288898) **Development of a laser doppler anemometer technique for the measurement of two phase dispersed flow. Doctoral thesis.** Srinivasan, J. (State Univ. of New York, Stony Brook (USA)). May 1978. 203p. NTIS PC A01/MF A01.

Thesis.

A new optical technique using laser doppler anemometry is presented for the measurement of the local number densities and two-dimensional velocity probability densities of particles in a dilute dispersed flow. The measurement involves discrimination on the signal amplitude, resident time, and frequency of Doppler signals caused by the scattered light from individual particles in the probing volume. A predominant direction of flow is assumed and the flow may be turbulent with a wide distribution of particle sizes.

45303 (UCRL—81973) **TOFS - A Timing Optical Fiber System.** Davis, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 14p. (CONF-790540—5). Dep. NTIS, PC A02/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

A technique has been established to accurately determine the position of a high velocity liner as it slides past or impinges on another surface. A small diameter optical fiber is accurately positioned relative to a target or liner. A bright light source (such as a small He—Ne laser) illuminates one end. The output from the other end is passed through a bandpass filter to a gated photomultiplier tube. Loss of the light signal thus accurately determines the time and position at which th fiber is broken by a passing liner. This technique is especially useful in environments where the presence of large magnetic fields or large circulating currents make the use of other techniques difficult (e.g., electrical shorting pins). This optical system is completely decoupled from environments having large electromagnetic noise levels. Shock waves in solid materials have been found to turn the fiber opaque during passage so that shock wave time of arrival studies are also feasible using the TOFS system.

45304 (UCRL—82276) **Stalking leaks at Livermore.** Conner, J.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1979. Contract W-7405-ENG-48. 5p. (CONF-790612—1). Dep. NTIS, PC A02/MF A01.

From Vacuum technology conference; Boston, MA, USA (5 Jun 1979).

Experience gained in the operation and maintenance of leak detection equipment is briefly described.

45305 **Tomographical imaging using uniformly redundant arrays.** Cannon, T.M.; Fenimore, E.E. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Appl. Opt.;* **18**: No. 7, 1052-1057(1 Apr 1979).

Recent work in coded aperture imaging has shown that the uniformly redundant array (URA) can image distant planar radioactive sources with no artifacts. This paper investigates the performance of two URA apertures when used in a close-up tomographic imaging system. It is shown that a URA based on m sequences is superior to one based on quadratic residues. The m-sequence array not only produces less noticeable defocus artifacts in tomographic imaging but is also more resilient to some described detrimental effects of close-up imaging. It is shown that, in spite of these close-up effects, the URA system retains tomographic depth resolution even as the source is moved close to the detector. The URAs based on m sequences provide better images than those obtained using random arrays. This compliments previous studies that have shown random arrays to have better tomographical properties than Fresnel zone plates and nonredundant arrays.

45306 **Determining particle concentration by statistics.** Kyle, T.G. (Los Alamos Scientific Lab., NM (USA)). *J. Aerosol Sci.;* **10**: No. 1, 87-93(Jan 1979).

It is possible to determine the mean concentration of particles within a sample volume through the mean and mean square signal of the measuring system. This determination is possible for particles of an unknown size or when the instrument response is uncalibrated. The results, which will be obtained when there are two independent particle distributions within the same volume, are given, and the conditions under which one of the distributions may be neglected are discussed.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 45140

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

45307 (LA-UR—79-810) **Explosive desensitization by preshocking.** Mader, C.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. (CONF-790621—1). Dep. NTIS, PC A02/MF A01.

From International meeting on combustion and detonation processes; Karlsruhe, F.R. Germany (27 Jun 1979).

Shock initiation of heterogeneous explosives proceeds by the process of shock interaction at density discontinuities such as voids which produces local hot spots that decompose and add their energy to the flow. The released energy strengthens the shock so that, when it interacts with additional inhomogeneities, higher temperature hot spots are formed and more of the explosive is decomposed. The shock wave grows stronger and stronger, releasing more and more energy until propagating detonation occurs. The process has been numerically modeled using the technique called Forest Fire. It describes the decomposition rates as a function of the shock pressure (the Pop plot) and the reactive and nonreactive Hugoniots. It has been observed that preshocking a heterogeneous explosive with a shock pressure too low to cause propagating detonation in the time of interest can cause a propagating detonation in unshocked explosive to fail to continue propagating when the detonation front arrives at the previously shocked explosive. The resulting explosive desensitization has been modeled using a Forest Fire decomposition rate that is determined only by the initial shock pressure of the first shock wave passing through the explosive. This model has been used to reproduce the experimentally observed explosive desensitization of

TATB (triaminotrinitrobenzene) explosives previously shocked by shortduration 80-kilobar pulses.

45308 (MHSMP—79-26) **Investigation of the effect of granule size on the mechanical properties of LX-14.** Johnson, H.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Apr 1979. Contract EY-76-C-04-0487. 13p. Dep. NTIS, PC A02/MF A01.

Tensile and diametric disc tests showed no significant difference between the coarse, medium, fine and standard granule size lots of LX-14. However, creep tests showed significant differences between lots. The creep failure time decreased with increasing granule size for both tensile and diameteric disc specimens. There were no significant differences between the failure strains in either the tensile or creep tests.

45309 (SAND—78-8784) **Variable explosive chamber test results.** Ng, R. (Sandia Labs., Livermore, CA (USA)). Jun 1979. Contract EY-76-C-04-0789. 31p. Dep. NTIS, PC A03/MF A01.

The Variable Explosive Chamber test was designed and developed for the determination of the pressure output relationships of explosives and pyrotechnics. The basic hardware consists of a pressure transducer; a slider into which an explosive actuator can be mounted facing the transducer; and a laser interferometer system. When the explosive is ignited, the resulting pressure forces the actuator-slider assembly out of a bore. The pressure transducer measures the pressure during this time of increasing volume. Simultaneously the laser interferometer system measures the slider's velocity which is converted into a volume or displacement history, whichever is more appropriate for the study. The resulting pressure and volume histories are used for the basic equation-of-state studies. Pressure-displacement relationships are best used for engineering design purposes. And finally, the importance of the VEC test is shown through its present use as an acceptance test for explosive actuators.

45310 (SAND—79-0935C) **High resolution Fourier transform infrared spectroscopy for the investigation of decomposition gases generated by aging organic materials.** Haaland, D.M.; Rivord, G.E. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 6p. (CONF-790632—6). Dep. NTIS, PC A02/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

A ten-year high explosives aging program is being conducted at Sandia. The goal of the program is to determine the long-term ambient temperature aging characteristics of pentaerythritol tetranitrate (PETN) and hexanitrostilbene (HNS) in explosive components. Because of the limited supply of components and the desire to study the aging process at temperatures as close to ambient as possible, a sensitive, nondestructive technique such as Fourier transform infrared spectroscopy (FTIR) is required. Of the major decomposition gases to be monitored (CO, CO_2, H_2O, NO, NO_2, N_2O, and N_2) only N_2 is not infrared active. Preliminary investigations of the FTIR method prior to its application to actual explosives are reported.

45311 **Detonation velocity transient of Composition B-3 and PBX-9404.** Davis, W.C. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Fluids;* **22**: No. 7, 1407-1409(Jul 1979).

Experimental measurements of detonation velocity as a function of charge length for Composition B-3 and PBX-9404 are reported. Initation was by a 200-mm-diam baratol lens. A transient decay time of about 10 μsec was observed in Composition B-3; no transient could be measured in PBX-9404.

NUCLEAR

REFER ALSO TO CITATION(S) 45438

45312 (AD-A—057787) **Airblast simulator design. Final report.** (Civil Nuclear Systems Corp., Albuquerque, NM (USA)). Jul 1978. Contract F29601-76-C-0166. 154p. NTIS PC A08/MF A01.

This study was undertaken to identify structural and simulator concepts for use in the development of designs for low-cost disposable airblast simulator facilities. Specifically addressed were the Dynamic Airblast Simulator (DABS), an explosively-driven shock tube, and the High Explosive Simulation Technique (HEST) an earth-covered, explosive cavity. For the DABS, alternative construction concepts, including parabolic arches, cable suspension systems, concrete box girders, long-span steel joists, composite deck system, aircraft shelter arches and circular concrete arches were evaluated for construction and cost feasability. High pressure HEST facility concepts and the use of HEST for testing above-ground structures were evaluated. The various airblast simulator concepts were compared and rated relative to one another.

45313 (SAND—79-0739) **Test plan: Bell Canyon Test WIPP experimental program. Borehole plugging.** Christensen, C.L. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 74p. Dep. NTIS, PC A04/MF A01.

The Bell Canyon Test (BCT) will be conducted in the abandoned exploratory well AEC-7. The hole will be reconditioned and deepened as necessary to intercept the production zone in the Bell Canyon (Ramsey Sands). Well bore characteristics and media permeability data will be obtained prior to plug installation. A minimum length plug will be installed to demonstrate that a cement grout plug can be installed to withstand hydrostatic pressure on the order of 2000 psi in a borehole. The well bore will be instrumented to monitor and identify fluid migration to the top of the plug. A time-controlled release tracer gas (SF^6) canister will be emplaced below the plug to permit measurement of gas migration through or around the plug.

WEAPONRY

45314 (LA—7833-MS) **Fireball shape as a height-of-burst diagnostic.** Jones, E.M.; Colvin, J.D. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

The shock wave produced by an atmospheric nuclear fireball reflects from the ground and strikes the bottom of the glowing fireball at the time when the sum of the fireball radius and the shock radius equals twice the burst height. RADFLO calculations have been used to define the function R(fireball) + R(shock) = f(Y,t). Fireball shape information is used to determine the time when shock/fireball interaction occurs and to derive the height-of-burst.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 44356

45315 (N—78-29674) **Study of effects of space power satellites on life support functions of the earth's magnetosphere. Final report.** Douglas, M.; Laquey, R.; Deforest, S.; Lindsey, C.; Warshaw, H. (Maya Development Corp., San Diego, CA (USA)). 5 May 1977. Contracts NAS7-100;JPL-954663. 152p. NTIS PC A08/MF A01.

The effects of the Satellite Solar Power System (SSPS) on the life support functions of the earth's magnetosphere were investigated. Topics considered include: (1) thruster effluent effects on the magnetosphere; (2) biological consequences of SSPS reflected light; (3) impact on earth bound astronomy; (4) catastrophic failure and debris; (5) satellite induced processes; and (6) microwave power transmission. Several impacts are identified and recommendations for further studies are provided.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 44250, 44251, 44256, 44257, 44259, 44260, 44726, 45360, 45365, 45407, 45433, 45456, 45516

45316 (CONF-790372—1) **Objective re-evaluation of a regional turbidity network.** Shannon, J.D.; Wesely, M.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From Quality assurance in environmental measurement conference; New Orleans, LA, USA (12 Mar 1979).

A regional network of ten turbidity sensors (silicon-cell pyranometers) was established in and around the Greater Northeast early in 1977. The selection of sensor positions was based in part upon simulations from an objective method for sensor-placement optimization. The method first fitted a continuous function to the discrete spatial and temporal correlations calculated from historical turbidity observations (made with a Volz sunphotometer), and then used that function, together with an initial array of sensor positions, in modeled objective analyses at gridpoints across the region of interest. The simulated sensor positions were shifted by nonlinear programming techniques until the explanation of variance in the modeled objective analyses was maximized. The resulting optimal sensor positions were then used as a guide in actual selection of sites, which had to meet constraints involving servicing, power, and field of view. Turbidity data obtained from the network during the summer of 1977 are used to re-evaluate the sensor positions. By calculating the incremental relative value of each sensor to analyses, candidates for elimination and for augmentation of other networks are selected.

45317 (CONF-790468—1) **What role can simulation model predictions play in environmental decisions: carbon dioxide as an example.** Emanuel, W.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From Institute of ecology workshop on information needs in environmental assessment; Indianapolis, IN, USA (8 Apr 1979).

Frequently, when an environmental issue requiring quantitative analysis surfaces, the development of a model synthesizing all aspects of the problem and applicable at each stage of the decision process is proposed. A more desirable alternative is to generate models specifically designed to meet the requirements of each level in decision making and which can be adapted in response to the changing status of the environmental issue. Various models of the global carbon cycle constructed to predict levels of CO_2 in the atmosphere as a result of man's activities are described to illustrate this point. In summary, the progression of models developed to analyze the global carbon cycle in resolving the CO_2/climate issue indicates the changing character of models depending on the immediate role they play in environmental decision making. The dominant and successful role served by models in the carbon cycle problem points to the desirability of this flexible approach.

45318 **Atmospheric dispersion modeling: a critical review.** Turner, D.B. (Environmental Protection Agency, Research Triangle Park, NC). *J. Air Pollut. Control Assoc.;* **29**: No. 5, 502-519(May 1979).

There are many requirements for dispersion models in the Clean Air Act Amendments of 1977 including prevention of significant deterioration, air quality maintenance plans, and new source permits. The historical perspective of dispersion modeling includes both theoretical and practical developments, rural and urban field studies including tracer studies, plume rise, and urban modeling. Photochemical modeling includes both grid point and trajectory models. Off-the-shelf models include level terrain models for elevated point sources, urban point and area sources, and transportation sources; and complex terrain models for point sources. Models are needed for photchemical pollutants, sulfates, and nitrates; they should treat long range transport, topographic effects build-up of urban cocentrations, and aerodynamic downwash. Emphasis is place herein upon proper interpretation of vertical temperature structure measurements, and the difficulties in determining the magnitude and locations of the highest and second highest concentrations in a year. Modeling improvements can be expected with representative on-site measurements of input parameters, and improved dispersion parameter schemes which must be verified with appropriate field investigations. Terms related to model evaluation are defined. A primary source of error, in comparing model estimates wih monitored air quality is not including the actual change of wind direction with height which determines elevated plume position. Measures for model evaluation will differ depending upon model use. The paper concludes asking for encouragement of model development, improvement of model inputs through on-site measurements, and detailed field investigations.

45319 (IVL-B—451) **Sampling and analysis of small contents of organic compounds in air.** Lindskog, A. (Swedish Water and Air Pollution Research Lab., Stockholm). Jul 1978. 32p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The objective of the project was to try to determine if, when sampling with MSA-tubes, there is any relationship between the recovery of a substance in a mixture and the molar weights, boiling points, and polarity of the component substances in the mixture. Despite a large number of samples, no such relationship was discovered. What was established, however, is that the recovery is less affected than what was indicated by earlier tests. The decisive factor in determining whether continued work is meaningful is the question of the precision required. The results reported here show that the deviation may at times reach 15 to 20%, but is often less. A given aim of the project was also to investigate whether sampling with MSA-tube and subseqent gas chromatographic analysis is a useful method for measuring solvents in work place atmospheres. For single solvents, the results indicate that the method is fully satisfactory. In the case where several solvents occur simultaneously, the results suggest two weaknesses: the risk of overloading the tubes leading to break-through, and increased imprecision of results. The usefulness will therefore be dependent on what measurement terror that can be accepted.

45320 (LBL—8696) **Atmospheric aerosol research. Annual report, 1977—1978.** Rosen, H. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 168p. Dep. NTIS, PC A08/MF A01.

Seventeen papers are included on the following topics: analytical methods development; physical and chemical characterization; atmospheric chemistry - laboratory studies; and atmospheric chemistry - modelling. Each paper was abstracted and indexed individually. (JGB)

45321 (LBL—8696, pp 2-10) **Optico-thermal analysis of the carbonaceous fraction of aerosol particles.** Dod, R.L.; Rosen, H.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

A previously reported method for the analysis of the carbonaceous component of atmospheric aerosol particulate materials by evolved gas analysis during a temperature-programmed combustion in oxygen was extended by constructing an apparatus that simutaneously measures the optical transmission of the particulate matter collected on a filter. Combustion thermograms from mobile and stationary sources, as well as thermograms of ambient particulate material from different geographical regions are illustrated. The method is quantitative for C within about 10%; reproducibility ranges from 3 to 5%. (JGB)

45322 (LBL—8696, pp 11-19) **Solvent-extraction-aided morphology study (SEAMS).** Benner, W.H.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Electron microscopy was used to study the changes in morphology of ambient particulate matter that can be induced by solvent extraction and heat treatment. The preliminary observations indicate the presence of a liquid-like material in submicron aerosol particles. This material can be removed by suitable solvent extraction or the heat treatment procedures to expose a core of agglomerates morphologically similar to carbon black.

45323 (LBL—8696, pp 20-27) **Contributions to the problem of quantitative infrared spectroscopic analysis of sulfates and nitrates in airborne particles: a modified sampling system.** Kellner, R.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Progress is reported in the development of a quantitative ir spectroscopic analysis of infrared active molecules or ions, especially sulfates, in microgram amounts of airborne particles. A sampling technique in which airborne particles are deposited on thin Cu and Al foils was modified to allow direct deposition on a KBr pellet that is located in the plane of the Cu surface. The modified sampling technique allows a quantitative transfer of aerosol samples down to 1 μg from the collection surface to the final sample pellet. A working curve for an ir spectroscopic $(NH_4)_2SO_4$ determination was established. The ir spectra of the aerosols collected showed more complexity in the sulfate region than do the ir spectra of $(NH_4)_2SO_4$. (JGB)

45324 (LBL—8696, pp 28-32) **Determination of nitrogen in atmospheric aerosols by proton activation analysis.** Clemenson, M.; Novakov, T.; Markowitz, S.S. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

A method of determination of one of the low-Z elements, nitrogen, utilizing protons of sufficient energy to induce the $^{14}N(p,\alpha)^{11}C$ nuclear reaction was developed. The radioactive decay of the 20.4-min ^{11}C is followed via its 0.511-MeV annihilation radiation. The method offers a simple approach to the problem of nitrogen analysis in atmospheric aerosols and is applicable to the routine analysis of these particles for nitrogen. Comparison of the nitrogen found by proton activation analysis and that found by an independent combustion method shows an average percent difference of 14% for the 17 samples analyzed. This difference is essentially the same whether one compares only the laboratory-prepared samples or the ambient samples. It should also be noted that the agreement between the two methods holds over a range which spans two orders of magnitude in nitrogen concentration. (JGB)

45325 (LBL—8696, pp 33-40) **Size-segregating aerosol sampler.** Hansen, A.D.A.; Schmidt, R.C.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Aerosol samplers were designed and constructed to the following requirements: to collect two parallel samples on prefired quartz fiber and Millipore filters; to require a minimum number of operations when changing filters; to have the option of complete aerosol collection or size-segregated collection (exclusion of particles of diameter $\geq$ 1.5 μm); to give an airflow rate of 1 to 2.5 m^3/cm^2-day through each filter, necessary to obtain suitable deposition for 24-hour samples of ambient air with carbon loadings in the range 5 to 30 $\mu g/cm^2$; and to be small, self-contained, and lightweight. A photograph and diagrams of the sampler are included. The method of operation is described. (JGB)

45326 (LBL—8696, pp 42-53) **Optical characterization of ambient and source particulates.** Hansen, A.D.A.; Rosen, H.; Dod, R.L.; Benner, W.H.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

The most striking feature of filter deposits collected in urban environments is their dark coloration, which is thought to be due to the strongly absorbing primary graphitic soot component. The graphitic component of filter-collected particulates may be conveniently measured because of its large optical absorption and used as a tracer for primary carbonaceous particles. The optical characterization of a

statistically large number of ambient and source samples taken under a wide range of conditions is reported. The central result is that primary material appears to compose a major fraction of the ambient carbonaceous aerosol studied in two California air basins under widely varying conditions. Furthermore, there is no evidence for the significant production of secondary carbonaceous particulate matter in correlation with the ozone concentration, a conventional indicator of photochemical activity.

45327 (LBL—8696, pp 54-57) **Optical attenuation: a measurement of the abosrbing properties of aerosol particles.** Rosen, H.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

The optical attenuation technique appears to be a direct measure of the absorbing component of aerosol particles and is apparently insensitive to its scattering properties. From a theoretical point of view, it is unclear why the backscattered radiation from nonabsorbing particles should not make a significant contribution to the optical attenuation measurement. This is especially true where the absorbing component represents only a small fraction of the aerosol mass. A simple theoretical model that accounts for reported abservations is presented, and the critical role of the filter substrate as an almost perfect diffuse reflector in the technique is pointed out.

45328 (LBL—8696, pp 58-65) **Identification of the optically absorbing component in urban aerosols.** Rosen, H.; Hansen, A.D.A.; Gundel, L.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Results of studies making use of an optical attenuation technique indicate that the species responsible for the high optical absorptivity of particulate samples has high temperature stability in air, is insoluble in a variety of solvents, and absorbs uniformly throughout the visible region. It was also demonstrated that the amount of the absorbing species is directly proportional to the graphitic soot content as defined by Raman spectroscopy. All these results taken together indicate that the high optical absorptivity of ambient samples collected in urban environments and various source particulate samples is due to the graphitic component of the aerosol.

45329 (LBL—8696, pp 68-78) **Characterization of source and ambient particulate samples by solvent extraction.** Gundel, L.A.; Mason, G.E.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Particulates collected under nonphotochemical conditions (Berkeley and New York City) appear very similar to particulates collected during a photochemical episode in the Los Angeles Basin when characterized by solvent extractin. There appears to be no substantial seasonal variation in S:P:E (secondary; primary; elemental carbon) ratios for Berkeley samples. Secondary to primary (polar to nonpolar) ratios based on extracts are close to 3 for all ambient particulates but less than 1 for source particulates. It is suggested that the significant differences between ambient and source samples may be due to chemical and physical transformation processes which do not require a photochemically active atmosphere. It was also found that a substantial amount (30 to 40%) of nonpolar carbonaceous material associated with source and ambient particulates is lost by evaporation during extraction with cyclohexane and benzene, implying that earlier measurements of total mass or carbon content of these extracts do not reflect the total amount of material extracted.

45330 (LBL—8696, pp 79—86) **Characterization of particulate amines.** Gundel, L.A.; Chang, S.G.; Clemenson, M.; Markowitz, S.S.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Both x-ray photoelectron spectroscopy (ESCA) and traditional analytical methods have helped characterize particulate nitrogen, but their results for NH_4^+, N/sub x/, and NO_3^- do not agree. Whereas ESCA samples are subject to volatility losses in high vacuum, expecially for NO_3^-, wet methods may modify the chemical composition of the samples by reactions such as hydrolysis, so that the technique affects the results. To reconcile the existing information and to further characterize particulate amines, proton activation analysis (PAA), was used in conjunction with ESCA for ambient particulate samples, before and after solvent extraction. ESCA was also used for the characterization of evaporated solvent extracts. Results indicate that a large fraction of N/sub x/ (85%) originally present in ambient particulate matter can be removed by water extraction (whereas NH_4^+ and NO_3^- are completely removed). Compared with the untreated sample, NH_4^+ concentration in the extract increases by approximately the same amount as the N/sub x/ concentration decreases. This behavior is attributed to the hydrolysis of amide groups. Extraction of particulate material with water may chemically change the nitrogen species so that the chemical composition of the extract is not representative of the original sample. Therefore, analytical methods based on extraction may give erroneous results. The conversion of particulate amides to NH_4^+ during extraction may yield NH_4^+ concentrations that are too high. (JGB)

45331 (LBL—8696, pp 88-99) **SO_2 oxidation by water droplets containing combustion nuclei.** Benner, W.H.; Rosen, H.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Preliminary results of a laboratory study in which water droplets having soot nuclei were exposed to SO_2 in a fog chamber are reported. This chamber study is thought to simulate a common tropospheric process - the condensation of water vapor onto nuclei to form fogs, plumes, and clouds in the presence of SO_2. Preliminary results of the experiments indicate that fog droplets containing soot nuclei are a very effective system for the oxidation of SO_2 to SO_4/ sup =/.

45332 (LBL—8696, pp 100-109) **Kinetics and mechanism of the reactions of NO/sub x/ with SO_2 in aqueous solutions.** Oblath, S.B.; Markowitz, S.S.; Novakov, T.; Chang, S.G. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

A study is underway to determine the products, kinetics, ad mechanisms of reactions occuring in the NO/sub x/—SO_2—H_2O(l) system under realistic atmospheric conditons and to assess the impact of these reactions on air quality. The present study measured the reaction rate of nitrites with bisulfites in the pH region between 3 and 7 at 20°C. Preliminary results indicate that the interaction of NO/sub x/ and SO_2 in an aqueous medium could be a very important source of sulfate and N_2O formation in the atmosphere.

45333 (LBL—8696, pp 110-123) **Kinetics and mechanism for the catalytic oxidation of SO_2 on carbon in aqueous suspensions.** Brodzinsky, R.; Chang, S.G.; Markowitz, S.S.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Research on the role of soot particles as catalysts for SO_2 oxidation was extended by studying the effect of liquid water on the soot-catalyzed reaction. A reaction rate law is presented, and a reaction mechanism for the catalytic oxidation of SO_2 on soot particles in an aqueous suspension is presented.

45334 (LBL—8696, pp 126-131) **Carbon and lead emission inventory for the greater San Francisco Bay area.** Hansen, A.D.A.; Benner, W.H.; Novakov, T.;. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Previously reported caluclations called for a dominant contribution of secondary carbonaceous material in the ambient urban aerosol of the Los Angeles air basin. In essence, this method considered that the major primary source of particulate carbon and lead was automotive emissions characterized by a [C/Pb] mass ratio of the order of 1. To account for an observed [C/Pb] mass ratio of the order of 6, a mass balance calculation was performed that required carbonaceous particulates of secondary origin to be present in quantities considerably exceeding the primary contribution. In this paper emission factor estimates and a similar calculation are presented to predict the inputs of particulate carbon and lead to the greater San Francisco Bay Area air basin. The results of this prediction are then compared with the results of the analysis of many ambient samples, and show that in principle it is possible to account for the observed ambient [C/Pb] ratio solely by proper consideration of source inputs.

45335 (LBL—8696, pp 132-137) **Relative importance of various sulfate production mechanisms in aqueous droplets.** Toossi, R.; Novakov, T.; Chang, S.G. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Atmospheric sulfate, a major constituent in ambient aerosol particles, is presumably formed by the oxidation of SO_2. The relative importance of various SO_2 oxidation mechanisms in aqueous droplets was compared. The systems considered in our box-type calculation are: SO_2—H_2O(l)—air; NH_3—SO_2—H_2O(l)—air; O_3—SO_2—H_2O(l)—air; NH_3—O_3—SO_2—H_2O(l)—air; Fe^{+3}—SO_2—H_2O(l)—air; NH_3—Fe^{+3}—SO_2—H_2O(l)—air; Mn^{+2}—SO_2—H_2O(l)—air; and soot—SO_2—H_2O(l)—air. It is concluded that the soot-catalyzed oxidation of SO_2 can be the dominant aqueous mechanism uder realistic atmospheric conditions. (JGB)

45336 (LBL—8696, pp 138-148) **Sulfur dioxide oxidation in a dispering plume.** Toossi, R.; Chang, S.G.; Pagni, P.J.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

Liquid water may condense on the soot particles when plumes of hot exhaust gases cool rapidly through mixing with ambient air or as they pass through fog and cloud banks. A model for SO_2 oxidation in a dry environment plume was presented earlier. The purpose of this study is to extend the model to predict the spatial distribution of sulfate concentration downwind from a plume resulting from aqueous oxidation of SO_2 catalyzed on soot particles. Results indicate that under certain meteorological conditions, catalytic oxidation of SO_2 on soot particles, emitted as the natural products of incomplete combustion, can be very important for the

production of sulfate in plumes. The discrepancies on the data reported in the literature on the SO_2 conversion rate might be related in part to variations in particulate emissions and ambient humidity.

45337 (LBL—8696, pp 149-161) **Lifetime of liquid water drops in ambient air: consideration of the effects of surfactants and chemical reactions.** Toossi, R.; Chang, S.G.; Novakov, T. 1978.

In Atmospheric aerosol research. Annual report, 1977—1978.

The general form of a governing equation describing evaporation and the growth of droplets was derived. It is assumed that the gaseous SO_2, CO_2, and NH_3 are in equilibrium with sulfite (IV), carbonate, and ammonium species in the aqueous droplet. Chemical equilibrium processes in the droplet—ambient system are listed. Calculations indicate that as the droplet evaporates, solute concentration increases and eventually the vapor pressure reaches below the ambient level and the droplet starts to grow again. Unfortunately, a short time later, the concentration of sulfate in the droplet is so high that the validity of Henry's Law and the Debye—Hueckel equations used in evaluating the activity coefficients fail and the calculations were stopped. Further work is under way to investigate behavior of the droplets under highly concentrated conditions. (JGB)

45338 (N—78-29692) **Air chemistry measurements in the lower atmosphere made from a small aircraft - data presentation.** Traegaardh, C. (Stockholm Univ. (Sweden). Meteorologiska Institutionen). Mar 1978. Contracts SWED-EPB-7-151/75;SWED-EPB-7-151/76. 136p. NTIS PC A07/MF A01.

A complete list of the data collected within the flight program is presented. Maps of the sampling areas and figures showing the vertical distribution of sulfur dioxide, sulfate, and light scattering from aerosol are presented.

45339 (NLCO—1159) **Feed Materials Production Center environmental monitoring annual report for 1978.** Boback, M.W.; Ross, K.N. (National Lead Co. of Ohio, Cincinnati (USA)). 1 May 1979. Contract EY-76-C-05-1156. 37p. Dep. NTIS, PC A03/MF A01.

Environmental monitoring data collected at the Feed Materials Production Center (FMPC) during 1978 are reported. These data show that the discharges of radioactive contaminants from FMPC operations were only a small fraction of the guide levels published in DOE Manual Chapter 0524. The resulting offsite radiation exposures would, therefore, be a small fraction of the standards for uncontrolled areas. Concentrations of environmentally important nonradioactive contaminants in water and air are also reported. Results show that FMPC operations did not cause State standards for these contaminants to be exceeded.

45340 (PB—284487) **Compilation of Air Pollutant Emission Factors. Third Edition (including supplements 1-7). Part A.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Aug 1977. 281p. NTIS PC A13/MF A01.

Emission data obtained from source tests, material balance studies, engineering estimates, etc., have been compiled for use by individuals and groups responsible for conducting air pollution emission inventories. Emission factors given in this document, the result of the expansion and continuation of earlier work, cover most of the common emission categories: fuel combustion by stationary and mobile sources; combustion of solid wastes; evaporation of fuels, solvents, and other volatile substances; various industrial processes; and miscellaneous sources. When no source-test data are available, these factors can be used to estimate the quantities of primary pollutants (particulates, CO, SO2, NOx, and hydrocarbons) being released from a source or source group.

45341 (PB—284488) **Compilation of Air Pollutant Emission Factors. Third Edition (including supplements 1-7). Part B.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Aug 1977. 236p. NTIS PC A11/MF A01.

Emission data obtained from source tests, material balance studies, engineering estimates, etc., have been compiled for use by individuals and groups responsible for conducting air pollution emission inventories. Emission factors given in this document, the result of the expansion and continuation of earlier work, cover most of the common emission categories: fuel combustion by stationary and mobile sources; combustion of solid wastes; evaporation of fuels, solvents, and other volatile substances; various industrial processes; and miscellaneous sources. When no specific source-test data are available, these factors can be used to estimate the quantities of primary pollutants (particulates, CO, SO2, NOx, and hydrocarbons) being released from a source or source group. (Portions of this document are not fully legible)

45342 (PB—284520) **Emission characterization of stationary NOx sources: Volume 1. Results. Special report.** Salvesen, K.G.; Wolfe, K.J.; Chue, E.; Herther, M.A. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Jun 1978. Contract EPA-68-02-2160. 247p. NTIS PC A11/MF A01.

The report gives results of an inventory of gaseous, liquid, and solid effluents from stationary NOx sources, projected to the year 2000, and ranks them according to their potential for environmental hazard. It classifies sources according to their pollution formation characteristics, and gives results of a compilation of emission factors and regional and national fuel consumption data for specific equipment/fuel types. It gives results of an emission inventory for NOx, SOx, CO, HC, particulates, sulfates, POM, and liquid or solid effluents. It projects emissions to 1985 and to 2000 for five energy scenarios, depicting alternative uses of coal, nuclear power, and synthetic fuels. It ranks sources by nationwide emissions loading for 1974, 1985, and 2000. It describes a source analysis model used to estimate pollution hazard, considering ambient dispersion, population exposure, background concentrations, and health-based impact threshold limits. It applies the model to the emission inventory to produce source rankings based on both single-pollutant and total-multimedia impact factors.

45343 (PB—284658) **National Emissions Data System (NEDS) fuel use report. (1974). Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Apr 1978. 128p. NTIS PC A07/MF A01.

This report summarizes annual estimates of total consumption of major fuels such as coal, fuel oil, natural gas, gasoline, and diesel fuel. Estimates of the consumption of a number of other comparatively minor fuels are also included. The data are distributed according to major categories of air pollutant emissions sources and are reported for the nation as a whole and for individual states, territories, and the District of Columbia. The data compilations are obtained from the U.S. Environmental Protection Agency's National Emissions Data System (NEDS). Portions of the NEDS data are reported to EPA by state agencies under the provisions of Section 110 of the Clean Air Act and EPA Regulations, Title 40, Code of Federal Regulations, Part 51.7.

45344 (PB—285162) **Photodissociation rates for minor species in the earth's atmosphere. Technical report.** Harris, R.D.; McCue, R.A.; Adams, G.W. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Space Environment Lab.). Sep 1977. 26p. NTIS PC A03/MF A01.

Photodissociation rates per molecule for ten minor atmospheric species have been computed as functions of wavelength, altitude, and solar zenith angle for medium solar activity. Calculations for wavelengths from the onset of dissociation to 1000 A and for altitudes below 110 km for CO, CO^{2+}, CH^{4}, C2H4, NO, NO2, N2O, H2O, $H^{3}O^{3}$, HNO^{3}, and the major species O^{3} and O^{2} are reported. Photodissociation calculations depend upon the atmospheric O^{2} and O^{3} absorption but are independent of specific minor species densities.

45345 (PB—285995) **Characteristics and meteorological impacts of pollutants from the Kennecott Copper smelter. Technical report.** Parungo, F.; Pueschel, R.; Ackerman, E.; Proulx, H.; Wellman, D. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Atmospheric Physics and Chemistry Lab.). Jan 1978. 27p. NTIS PC A03/MF A01.

To study the meteorological impact of the pollutants released by the Kennecott Copper smelter, Salt Lake City, Utah, airborne aerosol samples were collected on Nuclepore filters in the plume at different distances from the stacks. Electron microscopes were used to analyze the morphology, concentration, and size distribution of the aerosols. An x-ray energy spectrometer was used to determine the elemental composition of the individual particles. Chemical and physical properties were related to cloud condensation and ice nucleation activities, which were measured with thermal diffusion chambers. It was found that all the particles contained sulfur and were enveloped in a sulfuric acid liquid layer. The diameters of 95% of the particles were smaller than one micrometer. Most of the larger particles consisted of Si, Fe, Cu, Ca and/or Mg. Because of their hygroscopic acidic surface, the aerosols are active cloud condensation nuclei. The ice nucleation activity of the aerosol was found to increase with distance downwind. In conjunction with long atmospheric residence time due to the small size of the particles, long-range transport and effect on mesoscale cloud structures are possible.

45346 (PB—286201) **An approach for the preliminary assessment of TSP concentrations.** Pace, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Jul 1978. 78p. NTIS PC A05/MF A01.

Air quality data for Total Suspended Particulate (TSP) in 13 U.S. urban areas was examined. The data from 142 monitoring sites were grouped so that residential and commercial sites in non- or light-industrial urban areas could be examined. A relationship between height and concentration was noted at the sites with nearby

ground-level activity due to traffic, parking, etc., such that the concentration decreased exponentially with increasing height of the monitor above ground. No such relationship was found at sites with no ground-level activity. Commercial and industrial sites were found to be near ground-level activity in 90 percent of the cases examined while residential sites were virtually never located near such activity. The entire data base was then examined using a multiple regression procedure to estimate the relative impacts of non-industrial, general industrial, and steel mill influences on TSP levels. Non-industrial influences were found to account for over half of the total concentration estimate in all cases. Several potential applications of the linear regression technique are suggested. It can be used as a screening technique for examining TSP data to identify sites with unusual concentrations or to provide a preliminary estimate of sources of TSP. It can be used to interpret the variations in TSP data by estimating siting effects and it can help to identify the causes of discrepancies between predictions obtained with dispersion models and observations.

45347 (PB—286480) **Effect of environmental variables and sampling media on the collection of atmospheric sulfate and nitrate. Volume I. Final report.** Appel, B.R.; Tokiwa, Y.; Wall, S.M.; Hoffer, E.M.; Haik, M. (California Dept. of Health, Berkeley (USA). Air and Industrial Hygiene Lab.). Jan 1978. Contract ARB-5-1032. 180p. NTIS PC A09/MF A01.

A study was conducted to evaluate errors in the determination of atmospheric sulfate and nitrate employing filter sampling. Seven filter media were evaluated including Fluoropore, Whatman 41, Gelman GA-1, Gelman A, Gelman Spectrograde, Gelman EPA Grade and MSA 1106BH. The evaluation employed both field sampling and laboratory studies of the interaction of filter media, particulate matter and potential oxidation catalysts with pollutant gases (SO2, NO2, HNO3, NH3, O3). Field studies demonstrated that Fluoropore filter samples exhibited the lowest levels of artifact sulfate and nitrate, consistent with the behavior of clean Fluoropore filters in laboratory exposure studies. Glass and cellulose fiber high volume filter samples provided significant levels of both artifact sulfate and nitrate in field and laboratory studies. Particulate matter exhibited only a negligible role in influencing artifact sulfate. Manganese and copper oxides on filters were shown to produce sulfate from SO2 exposures. Soot, iron and vanadium oxides had no effect. (Portions of this document are not fully legible)

45348 (PB—286481) **Effect of environmental variables and sampling media on the collection of atmospheric sulfate and nitrate. Volume II. Appendices. Final report.** Appel, B.R.; Tokiwa, Y.; Wall, S.M.; Kothny, E.L.; Hoffer, E.M. (California Dept. of Health, Berkeley (USA). Air and Industrial Hygiene Lab.). Jan 1978. Contract ARB-5-1032. 79p. NTIS PC A05/MF A01.

Contents: Calibration and equivalency of high-volume air samplers for sulfate sampling study; Calibration of SO2, O3, NOx and NH3 analyzers; Nitric acid production; Calibration of the nitric acid monitors; Protocol for the determination of nitric acid by specific ion electrode; Determination of reactive silicate; Determination of phosphate; Determination of sulfite; Determination of filtration efficiencies; Intermethod comparison of alpha-XRFA sulfur and sulfate values on fluoropore filters; Adsorption isotherms for SO2-clean filter interactions; Nitrate contamination of the exposure system; Preparation of filters loaded with potential catalysts for SO2 oxidation; Carbon as a catalyst for SO2 to sulfate conversion. (Portions of this document are not fully legible)

45349 (PB—286556) **Sulfur isotope studies of biogenic sulfur emissions at Wallops Island, Virginia.** Hitchcock, D.R.; Black, M.S.; Herbst, R.P. (Environmental Research and Technology, Inc., Concord, MA (USA)). Mar 1978. 204p. NTIS PC A10/MF A01.

This research attempted to determine whether it is possible to measure the stable sulfur isotope distributions of atmospheric particulate and gaseous sulphur, and to use this information together with measurements of the ambient levels of sulfur gases and particulate sulfate and sodium in testing certain hypotheses. Sulfur dioxide and particulate sulfur samples were collected at a coastal marine location and their delta (34)S values were determined. These data were used together with sodium concentrations to determine the presence of biogenic sulfur and the identity of the biological processes producing it. Excess (non-seasalt) sulfate levels ranged from 2 to 26 micrograms/cu m and SO2 from 1 to 9 ppb. Analyses of air mass origins and lead concentrations indicated that some anthropogenic contaminants were present on all days, but the isotope data revealed that most of the atmospheric sulfur originated locally from the metabolism of bacterial sulfate reducers on all days, and that the atmospheric reactions leading to the production of sulfate from this biogenic sulfur source are extremely rapid. Delta^{34}S values of atmospheric sulfur dioxide correlated well with those of excess sulfate, and implied little or no sulfur isotope fractionation during the oxidation of sulfur gases to sulfate.

45350 (PB—286635) **Limited SO_2 and NOx measurements in St. Louis, 1974. Volume I. Plume tracking by correlation spectroscopy. Final report.** Sperling, R.B.; Vaughan, W. (Environmental Measurements, Inc., San Francisco, CA (USA)). Feb 1975. Contract EPA-68-02-1851. 216p. NTIS PC A10/MF A01.

A Barringer COSPEC spectrophotometer was used to measure the total overhead burden of SO2 and NO2 in the St. Louis urban plume and in the plumes of specific power plants in the St. Louis area. This information was combined with meteorological data to calculate SO2 fluxes in the plumes. A flame photometric sulfur monitor was used to determine ground level SO2 concentrations at points of plume touchdown. The data is presented in detailed maps and also in tabular form.

45351 (PB—286939) **Automatic interfacing system for sampling total mercury in stationary source emissions. Final report, June 1975—October 1976.** Sibbett, D.J.; Quinn, T.R. (Geomet, Inc., Pomona, CA (USA)). Aug 1978. Contract EPA-68-02-1789. 104p. NTIS PC A06/MF A01.

An interfacing system to sample total mercury emissions in source streams and suitably condition, dilute, and transport the sample to a mercury measuring instrument was designed, fabricated, and tested. The system consists of three components: a conditioner, a diluter, and a pump module. The conditioner contains a furnace to thermally decompose compounds at temperatures up to 1000C and a liquid scrubbing system to remove particulates and interfering gases, such as sulfur dioxide and nitrogen dioxide. The diluter module is used at sources where mercury levels are above the calibration range of the measuring instrument. The pump module draws the sample through the system, exhausts the waste scrubber liquid, and maintains a constant pressure in the analyzer. Field tests were conducted at a coal-fired power plant. Good correlation was obtained between the interface/photomatic analyzer and a reference manual procedure. Instrumental results ranged from 1.74 to 6.96 micrograms/cu m, with mean value of 4.23 micrograms/cu m; reference method results varied from 1.60 to 7.25 micrograms/cu m, with a mean value of 4.66 micrograms/cu m.

45352 (PB—287514) **Environmental outlook, 1977 national, regional and sectoral trends and forecasts 1975, 1985, 1990. Final report.** House, P.W.; Shull, R.D. (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Jul 1978. 79p. NTIS PC A05/MF A01.

This document contains projections of residuals from various energy and industrial activities which may enter the environment as an outcome of implementing the President's National Energy Plan (NEP) issued on April 29, 1977. The Strategic Environmental Assessment System (SEAS) was the comprehensive simulation model used to provide the projections. The projections encompass regional breakdowns by source for various pollutants in air, water, and solid wastes, including toxic substances. The trends are expressed as 1985 and 1990 multiples of their respective 1975 values.

45353 (PB—288195) **National air pollutant emission estimates, 1940-1976. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jul 1978. 37p. NTIS PC A03/MF A01.

This report presents estimates of trends in nationwide air pollutant emissions for the five major pollutants: sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides. Estimates are broken down according to major types of air pollutant sources. A short analysis of emission trends is given, along with a discussion of methods used to develop the data.

45354 (PB—288389) **Trace elements in soil around the Four Corners Power Plant. Final report.** Wiersma, G.B.; Crockett, A.B. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Aug 1978. 24p. NTIS PC A02/MF A01.

Ninety-six soil samples were collected on a radial grid employing 16 evenly spaced radii and 5 logarithmically spaced circles, concentric around the Four Corners Power Plant. The soil samples were analyzed for zinc, lead, copper, and cadmium by atomic absorption spectrophotometry. No statistical relationship could be detected between residue levels for the four elements and increasing distance from the power plant. A two-way analysis of variance indicated no significant difference among circles but there was a significant difference among radii for zinc, lead, and copper, with higher residues of these elements consistently indicated to the west of the power plant. Elevated levels of zinc, lead, and copper to the west of the power plant could be partially explained by wind rose patterns and the location of the fly ash settling ponds. Average residue levels for zinc, lead, and copper are below average residue levels reported for other power plants. Average cadmium levels are slightly higher than cadmium levels reported in the literature for other power plants.

45355 (PNL—2850(Pt.2), pp 1.3-1.7) **Hanford National Environmental Research Park [and] ecological monitoring for long-term effects.** Rickard, W.H.; Hinds, W.T.; McKenzie, D.H.; Baker, K.S.; Becker, C.D.; Cushing, C.E. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The Hanford National Environmental Research Park (NERP) includes the Arid Lands Ecology (ALE) Reserve, a 310 km^2 land area located on the western edge of the Hanford Site, in southcentral Washington. It is dedicated to ecological research. One of the aims of the NERP concept is to promote use of designated lands for research and educational purposes, which is being done on the ALE Reserve. The research conducted in the long-term ecological monitoring tasks is concerned with both terrestrial and aquatic ecosystems. Terrestrial ecology tasks are designed to detect subtle long-term buildups of potentially harmful airborne pollutants in terrestrial ecosystems in the northwestern United States. This will provide an early warning of harmful effects to high trophic level animals or potentially widespread loss of primary productivity as a result of chemical pollution associated with a variety of expanding energy technologies, especially fossil fuels. Tasks in aquatic ecology are intended to detect subtle changes in the chemical and/or physical properties of lakes and streams that might be deleterious to fish and other valuable aquatic species.

45356 (UCRL—51444-78) **Program report for FY 1978: Atmospheric and Geophysical Sciences Division of the Physics Department.** Knox, J.B.; Orphan, R.C. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1978. Contract W-7405-ENG-48. 76p. Dep. NTIS, PC A05/MF A01.

The Atmospheric and Geophysical Sciences Division (G Division) has served for several years as the focal point for atmospheric science research at Lawrence Livermore Laboratory. Historically, the strength of the program has been in the development, validation, and application of numerical simulation models of environmental systems of all sizes, ranging from the microphysics of pollutant scavenging to the global response of the climate system to perturbations. This report summarizes the major environmental issues addressed by G Division research, the technical objectives of the program, and the highlights of program accomplishments in FY 1978. A summary of G Division's numerical modeling capabilities is given, as well as an annotated bibliography of the division's publications in the atmospheric sciences during FY 1978. Supplementary material on budget and staffing is also included.

45357 **Data analysis procedures for the ozone NAAQS statistical format.** Curran, T.C.; Cox, W.M. (Environmental Protection Agency, Research Triangle Park, NC). *J. Air Pollut. Control Assoc.;* **29**: No. 5, 532-534(May 1979).

A new standard for ozone that states that the expected number of days per calendar year with daily maximum ozone concentrations exceeding 0.12 ppM must be less than or equal to 1 has been adopted. The new form of the ozone standard can be viewed as an evolutionary, rather than revolutionary, step in defining air quality standards. The incorporation of the concept of expected exceedances corrects certain problems with the previous form by extending the standard to multiple years and accounting for sampling frequencies. These changes were made in a manner that is fairly compatible with the previous form and consequently should be relatively easy to implement. The newform also provides a convenient framework for the determination of design values. Defining the allowable exceedance criterion statistically as an expected value permits the type of quantification necessary to determine the magnitude of the problem. In fact, it is probably in the area of design value estimation that the new form will have the most practical impact.

45358 (UCRL-Trans—1570) **Measurements of indoor air conditioned environment and practical evaluations of intake of atmospheric air. Part 4. Comparison of measurement results and simulation results. Part 5. Studies of simulation methods for optimal design of air-conditioned environments.** Nakahara, N.; Goto, T.; Nakajima, Y.; Kubo, K. Apr 1979. Translation of Japanese paper. (CONF-7810174—1(Trans)). 26p. Dep. NTIS, PC A03/MF A01.

From Scientific lecture meeting of society of heating, air-conditioning and sanitary engineers of Japan; Fukuoka, Japan (20 Oct 1978).

In the Osaka Ohbayashi Building, optimization controls of the intake of atmospheric air are incorporated, using the indoor CO_2 concentration as one of the indexes of the indoor environment. Previously reported results deal in detail with the correlations between the indoor CO_2 concentration, the number of people in the room, and the intake of atmospheric air. In the fourth paper, results are reported of a comparative study of the results of macroscopic simulation and the results of actual measuremets of the CO_2 concentration in a system in which the CO_2 concentration inside the main returning air duct is made to stand for the indoor CO_2 concentration in the entire building. The results showed rather good agreement between the measurement results and the simulation results. In the fifth paper, evaluations in terms of the dynamic contamination concentrations were made using a computer for a general model building. The CO_2 and dust were considered with reference to the air conditioning systems and the amounts of intake of atmospheric air. Cases where there were rather high rates of occupancy of offices were evaluated, and the results were used as materials for judging the dynamic effects. (JGB)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 45214, 45339, 45356, 45407

45359 (IS—4679) **Environmental monitoring at Ames Laboratory: Calendar Year 1978.** Voss, M.D. (Ames Lab., IA (USA)). Apr 1979. Contract W-7405-ENG-82. 58p. Dep. NTIS, PC A04/MF A01.

This is an annual report summarizing the effluent and environmental monitoring program at the Ames Laboratory of the Department of Energy. Earlier reports in this series concerned only environmental radioactivity and were each entitled "Survey of Environmental Radioactivity." The report for 1973 included some information on effluents, both radioactive and non-radioactive, with an assessment of the radiation dose to the public. The 1974 report was the first in the present series of reports. An inventory of the radioactive materials and certain chemicals released to the environment is included. A summary of the radioactivity found in the environment is presented. An estimate of the radiation dose to the public resulting from the operations of the Ames Laboratory is stated. The environmental program was modified in July of 1976.

45360 (MLM—2621) **Environmental monitoring during construction of the Miamisburg solar and fishing ponds.** Farmer, B.M.; Carfagno, D.G. (Mound Lab., Miamisburg, OH (USA)). 8 Jun 1979. Contract EY-76-C-04-0053. 26p. Dep. NTIS, PC A03/MF A01.

This study was an integral part of the Solar Pond construction activities in the Miamisburg Community Park. It provides reassurance that there was no significant risk to the health and safety of the construction workers, or to park visitors, from potential radiation exposures. Short-term (8-hr) and long-term (168-hr) air samples were collected and analyzed for plutonium-238, plutonium-239, and total suspended particulates. The short-term sampling was conducted only during periods of construction activity in the pond area. The long-term monitoring, however, had been and continues to be a part of Mound's normal environmental monitoring program, and is conducted on a continuous 24-hr/day, 7-day/week basis. Correlations of this plutonium monitoring data and the particulate loading data (concentration of particulate matter) demonstrate that the plutonium in the soil is available for resuspension. However, even assuming worst case conditions, the dose equivalent estimates for the construction workers and the individuals residing near the pond area are negligible. The dose equivalent estimates were calculated for both bone and lung from plutonium-238 and were found to be well within ERDA/DOE standards and USEPA proposed guidelines.

45361 (NTIS/PS—78/1205) **Nuclear power plants: ecology and health physics. Volume 1. 1964—November 1977 (a bibliography with abstracts). Report for 1964—November 1977.** Crockett, P.W. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 217p. NTIS PC N01/MF N01.

A compilation of references is presented on subjects related to the environmental impact of nuclear power plants. The following topics are included. Radiation dosage and hazards to animal life and humans; radiation exposure through food chains; radiation monitoring of the ambient environment and protection to personnel and surrounding populations; the effects of thermal pollution; and entrainment of aquatic animals.

45362 (NTIS/PS—78/1206) **Nuclear power plants: ecology and health physics. Volume 2. December 1977—October 1978 (a bibliography with abstracts). Report for December 1977—October 1978.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 66p. NTIS PC N01/MF N01.

A compilation of references is presented on subjects related to the environmental impact of nuclear power plants. The following topics are included: Radiation dosage and hazards to animal life and humans; radiation exposure through food chains; radiation monitoring of the ambient environment and protection to personnel and surrounding populations; the effects of thermal pollution; and entrainment of aquatic animals.

45363 (PB—286981) **Radioactivity standards distribution program, 1978—1979. Interim report, 1978—1979.** Ziegler, L.H. (Environmental Protection Agency, Las Vegas, NV (USA). Environmen-

tal Monitoring and Support Lab.). Jun 1978. 21p. NTIS PC A02/MF A01.

A program for the distribution of calibrated radioactive samples, as one function of EPA's quality assurance program for environmental radiation measurements, is described. Included is a discussion of the objectives of the distribution program and a description of the preparation, availability, and distribution of calibrated radioactive samples. Instructions and application forms are included for laboratories desiring to participate in the program. This document is not a research report. It is designed for use by personnel of laboratories participating or desiring to participate in the Radioactivity Standards Distribution Program, which is a part of the U.S. Environmental Protection Agency's quality assurance program.

45364 (PNL—2850(Pt.2), pp 8.3-8.4) **Investigation of microwave effects on terrestrial ecosystems (proposed).** Warner, M.L.; Davis, K.C.; Fox, K.; Rogers, L.E. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The purpose of a proposed study on microwave effects on terrestrial ecosystems is to identify any changes in organism populations or in whole ecosystems continuously exposed to the microwave frequencies and the power density levels that are anticipated in or near an operating Satellite Power System (SPS) receiving-antenna system. This information is necessary for the environmental assessment of the SPS concept and for planning and locating receiving-antenna sites. The initial planning effort described here confirmed the technical feasibility of constructing an adequate field exposure system, and it identified a battery of possible ecological studies that would be carried out using this exposure system. The information to be developed will aid in specifying the extent of buffer zones around the receiving antenna system.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

45365 (ORNL/TM—6883) **Storms over the METER—ORNL Precipitation Network: the first six months.** Miller, R.L.; Patrinos, A.A.N.; Saylor, R.E. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 551p. Dep. NTIS, PC A24/MF A01.

This report presents the first set of data collected by the METER—ORNL Precipitation Network. This network of 49 recording raingages and 5 recording windsets was installed in February 1978, around the Bowen Electric Generating Plant in northwest Georgia for the purpose of investigating the potential effect of the plant's cooling towers on rainfall. This study is conducted on behalf of the DOE Program on Meteorological Effects of Thermal Energy Releases (METER). Included in this report are the complete descriptions of 98 rainfall events which occurred over the METER—ORNL network during the period February 22—August 31, 1978. These descriptions are augmented by information and data supplied by the National Weather Service (NWS). Several stratifications of the rainfall events are performed for reference purposes.

45366 (PB—286980) **Prediction of turbulent jets and plumes in flowing ambients. Technical report.** Hwang, S.S.; Pletcher, R.H. (Iowa State Univ. of Science and Technology, Ames (USA). Heat Transfer Lab.). Aug 1978. 135p. NTIS PC A07/MF A01.

A differential approach for the analysis of the behavior of turbulent, axisymmetric buoyant jets and plumes discharged into a crossflowing ambient is presented. The thin shear layer form of the governing partial differential equations for the conservation of mass, momentum and energy, derived in a curvilinear, orthogonal coordinate system is solved numerically by a fully implicit finite-difference technique. A 'lumped' analysis is proposed to simplify the momentum equation in the transverse direction. The turbulent shear stress and heat flux terms appearing in the governing equations are evaluated through turbulent viscosity and conductivity models which contain parameters related to buoyancy and streamline curvature. Comparisons between predictions and experimental data are presented. In a second part of this study, a finite-difference solution method was developed and applied to predict three-dimensional, laminar jets discharged from a square or rectangular orifice. These discharged jets or plumes are a contributing factor to air or water pollution.

REGULATIONS

REFER ALSO TO CITATION(S) 45357

45367 (EPA—450/3-78-049) **Legal issues of emission density zoning.** Jaffe, M.S.; Mandelker, D.R.; Thomas, W.A.; Wafer, D.B.; Taub, F. (American Society of Planning Officials, Chicago, IL). Sep 1978. Contract W-31-109-ENG-38. 142p. Dep. NTIS, PC A07/MF A01.

Emission density zoning (EDZ) is an air pollution control strategy that sets emission limits for certain areas of land; these limits restrict the rate of pollutant emission per unit area (such as grams per second per hectare). Legal issues involving EDZ are examined. Many of the legal arguments applied to EDZ, and the conclusions reached, also may be applied to other types of land-use-based emission quota strategies, such as floating zone emission quotas, jurisdictional emission quotas, and district emission quotas. EDZ can be considered as either a land-use or air pollution control technique; each interpretation raises different legal questions. EDZ probably would be upheld as a valid technique under the Clean Air Act and its amendments, but modifications of state air pollution control or land-use-management enabling legislation may be needed to ensure implementation. EDZ also raises constitutional questions of equal protection and due process, but these issues largely depend on the particular administrative mechanisms used to implement EDZ. Legal issues also may arise if EDZ is considered a pollution dispersal rather than a pollution abatement strategy. The legal questions concerning EDZ may best be resolved through explicit state enabling legislation that clearly delegates authority to local, regional, and state agencies, and establishes strong mechanisms for intergovernmental coordination.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 44726, 45473, 45479

45368 (CONF-790462—1) **Dimensions of ecosystem theory.** O'Neill, R.V.; Reichle, D.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 43p. Dep. NTIS, PC A03/MF A01.

From Colloquium on Ecosystem analysis; Corvallis, OR, USA (26 Apr 1979).

Various dimensions of ecosystem structure and behavior that seem to develop from the ubiquitous phenomena of system growth and persistence were studied. While growth and persistence attributes of ecosystems may appear to be simplistic phenomena upon which to base a comprehensive ecosystem theory, these same attributes have been fundamental to the theoretical development of other biological disciplines. These attributes were explored at a hierarchical level in a self-organizing system, and adaptive system strategies that result were analyzed. Previously developed causative relations (Reichle et al., 1975c) were examined, their theoretical implications expounded upon, and the assumptions tested with data from a variety of forest types. The conclusions are not a theory in themselves, but a state of organization of concepts contributing towards a unifying theory, along the lines promulgated by Bray (1958). The inferences drawn rely heavily upon data from forested ecosystems of the world, and have yet to be validated against data from a much more diverse range of ecosystem types. Not all of the interpretations are logically tight - there is room for other explanations, which it is hoped will provide fruitful grounds for further speculation.

45369 **Niche pattern in a forest-floor small-mammal fauna.** Dueser, R.D. (Univ. of Michigan, Ann Arbor); Shugart, H.H. Jr. *Ecology;* 60: No. 1, 108-118(Feb 1979).

This study examines the relationships among 4 small mammal species in 2nd-growth mesic forest on Walker Branch Watershed in eastern Tennessee, USA. Populations of Blarina brevicauda, Peromyscus leucopus, Ochrotomys nuttalli and Tamias striatus were live-trapped on 90.36-ha grids during the summer of 1973. Eight measures of physical habitat structure were used in discriminant analysis of the microhabitats occupied by these 4 species. Three statistically significant discriminant functions were calculated. Each discriminant function is represented as an axis in a 3-dimensional descriminant space. These 3 axes are interpreted as vegetation type, vegetation structure and litter-soil surface characteristics. The positions of the species in the discriminant space characterize the microhabitat configurations of the species relative to the ecological properties attributed to the axes. Each species differs significantly from every other species on at least 1 axis. The observed species differences are conservative estimates of microhabitat (structural niche) segregation. We propose measures of niche position (i.e., exploitation specialty) and niche breadth based on the discriminant analysis. Species i is represented by a cloud of n/sub i/ sample points in the discriminant space. Sample point j for species i lies the distance d/sub ij/ from the origin of the space. The average of these distances (anti d/sub i/)

represents the average position for species i relative to the origin. Because this origin represents the average of the microhabitats sampled on the watershed, and because the microhabitats actually occurring on the watershed are assumed to vary continuously the likelihood of a species encountering favored microhabitat on Walker Branch decreases as anti d increases. This anti d is, thus, interpreted as an index of niche position relative to the average of the microhabitats sampled.

45370 **Microbial ecology.** Loutit, M.W.; Miles, J.A.R. (eds.). New York, NY; Springer-Verlag (1978). 474p. (CONF-770862—).

From International symposium on microbial ecology; Dunedin, New Zealand (22 Aug 1977).

The first three sections of the conferences were concerned with general, marine, and freshwater microbial ecology. Other sections of the conference discussed the following topics: biodegradation in aquatic environments; microbial ecology of soils; microbial ecology of animals; microbial ecology of plants; environmental problems management and control; and microbiology of food. (HLW)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 44250, 44251, 45339, 45352, 45354, 45355, 45391

45371 (PNL—2850(Pt.2), pp 1.9-1.21) **Terrestrial ecology [and] restoration of surface-mine lands.** Rogers, L.E.; Sauer, R.H. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Terrestrial ecology studies, undertaken to determine the important plant and animal species that comprise ecosystems on the Hanford Site, investigate the responses of these ecosystems to various landscape perturbations, such as shallow land burial, plowing, fire, livestock grazing, weather, and their responses to more static features of the landscape such as topography and soil. Sampling is an inherent part of quantitative ecology measurement; various sampling designs and strategies are tested during field studies. Long-term studies are conducted to evaluate the ecological success of self-established biotic communities on severely disturbed habitats. The behavior of potentially toxic mineral elements and those essential to plant and animal growth are being studied to establish baseline values before coal-fired power stations become operational in south-central Washington and adjacent Oregon. Dietary habits of animals are studied to establish meaningful food webs and material transfers between ecological trophic levels. Land restoration of surface mines involves rainfall harvest, soil placement, slope treatment and plant species selection to restore surface-mined lands to plant production without the need for irrigation. Crop plants are selected to provide food for people and/or livestock. This research is conducted on the Hanford Site, the most arid portion of Washington State (ppt < 7 inches), and on an active mine site in Arizona.

45372 (PNL—2850(Pt.2), pp 2.3-2.8) **Terrestrial effects of oil shale development.** Wildung, R.E.; Garland, T.R.; Bean, R.M. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Studies on chemical/biochemical transformations in retorted shales and soils and their relationship to water quality, viability of green plants, and human food chains are reported. Both retorted shale and retort water from the Paraho Oil Shale Demonstration Project were analyzed in an effort to determine properties of effluents disposed to the ground. Preliminary studies on mobility of soluble inorganic and organic residuals are under way. Results of studies on the microbiology of effluents disposed to the ground indicate that bacteria can utilize the organic residues of retorted shale for growth and can modify the organic compounds of the retorted shale. (JGB)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 44401, 45339, 45363, 45391, 45398

45373 (PNL—2850(Pt.2), pp 5.17-5.23) **Radioecology of nuclear fuel cycles.** Schreckhise, R.G.; Emery, R.M.; Rogers, L.E.; Cadwell, L.L.; Cline, J.F.; Fitzner, R.E.; Gano, K.A.; Poston, T.M.; Rickard, W.H. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Sites where radioactive wastes are found are solid waste burial ground, soils below liquid storage areas, surface ditches and ponds, and the terrestrial environment around chemical processing facilities that discharge airborne radioactive debris from stacks. This study provides information to help assess the environmental impacts and certain potential human hazards associated with nuclear fuel cycles. A data base is being developed to define and quantify biological transport routes which will permit credible predictions and assessment of routine and potential large-scale releases of radionuclides and other toxic materials. Progress is reported in studies on terrestrial and aquatic radiology of waste management areas, biotic transport parameters (uptake and distribution of ^{232}U in peas and barley), and chemical speciation for uptake studies (^{233}U movement within a soil column). (JGB)

45374 (PNL—2850(Pt.2), pp 5.25-5.27) **Environmental behavior and effects of Technetium-99 and Iodine-129.** Garland, T.R.; Schreckhise, R.G.; Wildung, R.E.; Cadwell, L.L.; McFadden, K.M.; Cataldo, D.A. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The specific objectives of this program are to determine the soil physicochemical and microbiological factors and physiological parameters that govern the mobility and bioavailability of different chemical forms of ^{99}Tc and ^{129}I in terrestrial and aquatic environments and to validate and measure food web transport in selected field locations. These are the major accomplishments of the past year: (1) field sites were located near fuels reprocessing facilities where levels of technetium exist in plant tissues 15 to 600 times the predicted levels due to world wide fallout from weapons testing, (2) kinetic analyses of absorption isotherms suggested that TcO_4^- was actively absorbed by mechanisms functioning for nutrient ions, (3) metabolic studies of inhibition of the previously noted phytotoxicity of technetium indicated no pronounced effect on nitrate reduction, photosynthesis or respiration following short-term exposure, (4) transport of technetium in the xylem stream occurred as TcO_4^-, but the technetium deposited in leaves and roots (95% soluble in weak buffers) was shown to be associated with several ligands with apparent molecular weight > 5000, (5) availability of technetium in plant tissue to animals was less than TcO_4^- administered in drinking water, (6) concentration ratio of technetium for a single species of algae (Selenastrum) was ~ 2, while several species of bacteria and fungi ranged from 40 to 170, (7) reduced availability of technetium was demonstrated under simulated irrigation practices in contrast to small container growth chamber studies; and (8) the release of volatile forms of iodine from soil and subsequent adsorption of gaseous iodine by plant foliage was demonstrated and evaluated in terms of impact on the iodine cycle.

SOIL

REFER ALSO TO CITATION(S) 44391, 44398, 45360, 45453, 45472

45375 (PNL—2850(Pt.2), pp 5.3-5.5) **Transuranic behavior in soils and plants.** Wildung, R.E.; Garland, T.R.; McFadden, K.M.; Rogers, J.E.; Cataldo, D.A.; Sullivan, M. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The principal objectives of these investigations are to determine: the potential for alteration of transuranic solubility through formation of transuranic complexes in soil and the role of the soil microflora in this process; the extent of uptake and translocation by plants and the sites of plant deposition of transuranics or their complexes; the bond types; chemical forms of transuranics of their metabolites in microbes, plant tissues, and soils; the influence of soil properties, environmental conditions and cropping on these processes; and the retention of airborne pollutants by plant foliage and their subsequent absorption by leaves and transport to seeds and roots. A model for the environmental behavior of Pu was developed. Results of studies on the foliar interception and behavior of Pu and Am are discussed.

45376 (PNL—2850(Pt.2), pp 5.13-5.15) **Transuranic weathering in plants.** Schreckhise, R.G.; Cline, J.F.; Cadwell, L.L. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Information is reported on the effects of weathering and aging on the uptake of transuranics from soil by range and crop plants grown under realistic field conditions. A comparison was made of the uptake of the nitrate forms of ^{238}Pu, ^{239}Pu, ^{241}Am, ^{244}Cm and ^{237}Np from soil into selected parts of four plant species

grown under field conditions. The relative plant uptake of the four transuranium elements was Np > Cm ≃ Am > Pu. Relative uptake values of neptunium into various plant parts ranged from 2,200 to 45,000 times as great as for plutonium, while americium and curium values were 10 to 20 times greater. Results are reported of studies on the concentration of ^{238}Pu in field lysimeters at various depths below soil surface following four harvest seasons. (JGB)

45377 (PNL—2850(Pt.2), pp 10.3-10.8) **Rockwell support studies.** Rogers, L.E.; Cadwell, L.L. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Studies were designed either to (1) clarify the role of specific biota in the uptake and transport of radionuclides from shallow, low-level waste burial sites or (2) evaluate the radioactive exposure levels to biota inhabiting such sites. Tasks include studies on burrowing animals and shrub-inhabiting insects, dose distribution evaluation, environmental assessment of raptors, study of radionuclide levels in blacktailed hares, field plant uptake studies, plant uptake (laboratory) studies and burial ground stabilization studies.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 45361, 45362, 45375, 45376, 45377

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 44253, 45430

45378 (DOE/SR/00870—6) **Microbial ecology of amended soil in borrow pits planted to loblolly pine.** Wojcik, V.H.; Marx, D.H. (Forest Service, Athens, GA (USA). Southeastern Forest Experiment Station). Apr 1979. Contract EY-76-A-09-0870. 6p. Dep. NTIS, PC A02/MF A01.

Microbial assessments of variously amended soil in a pine ectomycorrhizae reclamation study installed in 1976 on a borrow pit at the Savannah River Plant, Aiken, South Carolina were done in 1978. Results revealed that the sludge amended soils compared to inorganically amended or nonamended soils have: (1) 3X the number of soil fungi; (2) larger populations of cellulose degrading fungi, Trichoderma, Aspergillus and Penicillium; (3) cellular slime molds which are indicative of a developing litter layer and a large bacteria population; (4) a larger number of yeast; (5) basidiomycete mycelia penetrating organic matter in the soil; (6) winter bacteria populations that are 3X greater; (7) summer bacteria populations that are 10X greater; (8) a large number of endomycorrhizae on the herbaceous plants; and (9) a moss layer, indicative of high nitrogen levels, developed under both herbs and pines. These observations strongly suggest that the processes of mineral recycling in the sludge amended plots are developing rapidly after only three growing seasons. These microbial results reflect the tremendous growth of the pine and grass in the sludge amended plots.

45379 (DOE/TIC—10094) **Projected acreage of prime farmland to be disturbed by coal surface mining in the corn belt, 1980—2000.** Bernard, D.P. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

In the 20-year period 1980—2000, 433,000 acres of land in the Corn Belt are forecast to be affected by surface mining for coal. Of this land area, 122,000 acres are expected to be prime farmland, which is equivalent to 0.2% of the total regional prime farmland area. During this same period, over 3 million acres of prime farmland could be affected by urban expansion, road building, and water projects if current trends continue. Overall, the acreage of prime farmland affected by mining is significant, especially at the local level. Considering the small amount of prime farmland which has successfully been returned to crop production, the resulting challenge to reclamation specialists is large.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 44725, 44727, 44728, 45370

45380 (PB—286947) **Chesapeake Bay baseline data acquisition, toxics in the Chesapeake Bay. Final preliminary report, 1946-78.** (Chesapeake Research Consortium, Inc., Baltimore, MD (USA)). Jul 1978. Contract EPA-68-01-3994. 277p. NTIS PC A13/MF A01.

This report identifies researchers, research activities, and data files applicable to the Chesapeake Bay estuarine system. The identified data were generated after 1973 on the following: submerged aquatic vegetation, shellfish bed closures, eutrophication, toxics accumulation in the food chain, dredging and spoil disposal, hydrologic modifications, modification of fisheries, shoreline erosion, wetlands alterations, and the effects of boating and shipping on water quality. Major past and current program monitoring in the Bay and its tributaries are summarized according to frequency.

45381 (PB—288310) **Development of an operational northern aquatic ecosystem model.** Carlson, R.F.; Fox, P.M.; LaPerriere, J.D. (Alaska Univ., College (USA). Inst. of Water Resources). Jun 1977. Contract DI-14-31-0001-5217. 15p. NTIS PC A02/MF A01.

Adaptation of a pre-existing model ecosystem was studied for application to management problems of northern lakes and suggestions were made for appropriate strategy for simulating aquatic ecosystems in cold regions. Harding Lake was used as a case study because it is easily accessible, located 80 km southeast of Fairbanks. Also, it is a rather large, deep subarctic lake and provided good field data for the modeling project. Areas of interest included general constituent levels, certain aspects of lake geometry, and climatic conditions. Spring breakup is a very important season in arctic limnology, yet is difficult to simulate because of the unstable nature of the water column during that period. Potential applications for the model were identified, including reservoirs of a large hydroelectric project in southcentral Alaska, a salmon hatchery supply lake, and other lake and reservoir management schemes throughout the state.

45382 (PNL—2850(Pt.2), pp 10.11-10.12) **Service assessment studies.** Watson, D.G.; Rickard, W.H. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Service assessment studies involve the long-term ecological monitoring of several important animals likely to be impacted by the industrial development of the 1475 km^2 Hanford Site. Data on the spawning of chinook salmon studied in a series of observations now in its third decade are reported.

45383 **Genetic variability in the pelagic environment: a paradox.** Ayala, F.J.; Valentine, J.W. (Univ. of California, Davis). Contract PA 200-14. *Ecology;* **60**: No. 1, 24-29(Feb 1979).

The pelagic environment is often regarded as rather homogeneous by comparison with shallow-water benthic environments. Species of krill of the pelagic genus Euphausia (Crustacea) display a trend in genetic variability from low in high latitudes to high in low latitudes, closely similar to trends displayed by shallow-water benthic invertebrates. We interpret the trends as genetic strategies, with few functionally-broad alleles in high latitude species or in species that range widely ecologically, and numerous functionally-narrow alleles in low latitude species that are narrowly restricted ecologically. The functionally-narrow alleles are maintained by forms of balancing selection and permit a high degree of specialization. Therefore the tropical krill species are highly sensitive to spatial heterogeneities within the pelagic zone, which does not appear homogeneous to selection.

45384 **Effects of food quality on growth of a stream detritivore, Paratendipes albimanus (Meigen) (Diptera: Chironomidae).** Ward, G.M.; Cummins, K.W. (Michigan State Univ., Hickory Corners). Contract EY-76-02-2002. *Ecology;* **60**: No. 1, 57-64(Feb 1979).

Laboratory-determined larval growth rates of the detritivore (collector-gatherer) Paratendipes albimanus (Chironomidae) responded proportionally to the microbial densities of 4 food sources. Substrates with higher microbial activities and biomasses produced greater growth rates in order: pignut hickory (Carya glabra) leaves > white oak (Quercus alba) > insect feces > natural stream detritus. Laboratory growth rates of P. albimanus were linearly related to quantitative estimates of food quality based on substrate adenosine triphosphate (ATP) and respiration rates but were not statistically related to total N or C. Although P. albimanus is univoltine in Augusta Creek, Michigan, an experimental laboratory population of first-instar larvae completed a 2nd generation during the summer when fed detritus generated from hickory leaves. A second experimental population failed to develop past the first instar when fed natural detritus. The natural growth pattern of P. albimanus involves the interaction of temperature and food quality.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 45386, 45387

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 44250, 44251, 44318, 44325, 44327, 45339, 45342, 45352, 45355, 45359, 45372, 45380, 45407, 45458, 45459

45385 (AD-A—058001) **Aquatic disposal field investigations, Duwamish waterway disposal site, Puget Sound, Washington. Appendix D. Chemical and physical analyses of water and sediment in relation to disposal of dredged material in Elliott Bay. Volume II. September-December 1976. Final report.** Sugai, S.; Schell, W.R.; Nevissi, A.; Olsen, S.; Huntamer, D. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). Jun 1978. Contract DACW39-76-C-0167. 135p. Availability: Microfiche copies only.

This report presents results obtained in a study conducted to evaluate the extent and duration of changes in chemical characteristics of Elliott Bay, Washington, six and nine months after disposal of dredged materials from the Duwamish River. The seawater, sediment, and interstitial water were analyzed for the following chemical parameters: (1) seawater--suspended solids, arsenic, manganese, mercury, reactive silicate, inorganic phosphate, nitrate, and ammonia; (2) sediment--free and total (acid soluble) sulfide, manganese, chromium, arsenic, mercury, and particle size; and (3) interstitial water--arsenic, manganese, reactive silicate, ammonia, and inorganic phosphate. Temporal, depth, and spatial changes in concentrations of chemical variables were evaluated at disposal and reference sites. The results of analyses showed only minimal changes in trace metal concentrations in the water column above the disposal site, but lower Eh and pH values in the sediments than at the reference site. The manganese, inorganic phosphate, and ammonia concentration values were greater in interstitial waters at the disposal site than at the reference site.

45386 (DOE/EV/70040—6) **Hydrocarbon studies in Puget Sound and off the Washington coast. Progress report, March 1977—February 1978.** Carpenter, R.; Fairhall, A.W. (Washington Univ., Seattle (USA). Dept. of Oceanography). 1978. Contract EY-76-S-06-2225-040. 88p. (RLO—2225/T40-6). Dep. NTIS, PC A05/MF A01.

This report summarizes progress in the first 2.5 yrs of our studies of the amounts, types, and probable origins of aliphatic, aromatic, S-, and N-containing hydrocarbons in sediments, organisms, and waters of Puget Sound and the Washington coast. We are trying to identify the relative importances of the various possible sources of these substances, the major pathways by which they are transferred through some parts of the marine food web, their rates of transfer, and their ultimate fates. We have found that changes in aliphatic and aromatic hydrocarbon compositions are evident in ^{210}Pb dated sediment cores from central Puget Sound. These changes are due both to natural diagenetic processes and to low level inputs of fossil fuels from a variety of sources. We have found measurable amounts of both S- and N-containing compounds in these Puget Sound sediments. We believe the first results of our studies of the role of zooplankton fecal pellets in the cycling of trace chemicals in the sea have shown that fecal pellets are an important vertical transport agent for hydrocarbons in the sea. We now have defined the natural variations in ^{14}C and $^{13}C/^{12}C$ isotope ratios of the inorganic carbon in Puget Sound seawater. Carbon isotope abundances for organisms and sediments are also reported for selected sites.

45387 (DOE/EV/70040—9) **Hydrocarbon studies in Puget Sound and off the Washington coast. Progress report, March 1978—February 1979.** Carpenter, R.; Fairhall, A.W. (Washington Univ., Seattle (USA). Dept. of Oceanography). 1979. Contract EY-76-S-06-2225-040. 44p. (RLO—2225-T40-9). Dep. NTIS, PC A03/MF A01.

This report summarizes the past year's progress in our studies of the amounts, types, and probable origins of aliphatic, aromatic, S-, and N-containing hydrocarbons in sediments, organisms, and waters of Puget Sound and the Washington coast. We are trying to identify the relative importance of the various possible sources of these substances, the major pathways by which they are transferred through some parts of the marine food web, their rates of transfer, and their ultimate fates. We have found that changes in aliphatic and aromatic hydrocarbon compositions are evident in ^{210}Pb-dated sediment cores from central Puget Sound. These changes are due both to natural diagenetic processes and to low-level inputs of fossil fuels from a variety of sources. We have found measurable amounts of both S- and N-containing compounds in these Puget Sound sediments. Our studies of the role of zooplankton fecal pellets in the cycling of trace chemicals in the sea have shown that fecal pellets are an important vertical transport agent for hydrocarbons in the sea. We now have defined the natural variations in ^{14}C and $^{13}C/^{12}C$ isotope ratios of the inorganic carbon in Puget Sound seawater. Carbon isotope abundances for organisms and sediments are also reported for selected sites.

45388 (ORNL/TM—6555) **Characterization of nonvolatile organics in disinfected wastewater effluents: interim report.** Jolley, R.L.; Cumming, R.B.; Denton, M.S.; Lee, N.E.; Pitt, W.W.; Hartmann, S.J.; Lewis, L.R.; Thompson, J.E.; Mashni, C.I. (Oak Ridge National Lab., TN (USA)). Feb 1979. Contract W-7405-ENG-26. 88p. Dep. NTIS, PC A05/MF A01.

Concentrates of chlorinated primary sewage effluents are highly mutagenic in bacterial tester strain TA-1535 and negative in other strains used. All other concentrates, regardless of treatment, have been negative in mutagenic tests. Some mutagenic activity was detected in fractions from the HPLC separation of the active chlorinated primary concentrates, but much of the mutagenic activity is apparently lost or inactivated during the separation process. The mutagenic activity tests thus become a very useful adjunct to analytical studies on treated effluents. Fourteen 40-liter field samples have been collected in seven collecting operations at five different sites. Chromatography and characterization of chromatographic constituents is proceeding. Thymine and uracil were identified and 14 other unknown compounds were characterized in an untreated secondary effluent control sample from the ozonation pilot plant at the Wastewater Research Division, Municipal Environmental Research Laboratory, Cincinnati. Eleven unknown compounds in the ozonated effluent were characterized with respect to gas chromatography and mass spectra. Disinfection of wastewater effluents by chlorination destroys some nonvolatile chromatographic constituents and produces other nonvolatile compounds. Disinfection of wastewater effluents by ozonation destroys some nonvolatile chromatographic constituents and produces other nonvolatile compounds. Disinfection of wastewater effluents by uv-light irradiation has relatively little chemical effect on nonvolatile chromatographic constituents.

45389 (PB—284296) **Program review proceedings of: environmental effects of energy related activities on marine/estuarine ecosystems.** Hall, C.; Preston, W. (Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry). Oct 1977. 303p. NTIS PC A14/MF A01.

Fiscal year 1975 was the beginning of the Environmental Protection Agency's lead responsibility for the planning, coordination, and implementation of the Federal Interagency Energy/Environment RandD Program. The 'Report of the Interagency Working Group on Health and Environmental Effects of Energy Use,' completed in November 1974, recommended an integrated environmental sciences research program addressing needs in five major areas: pollution characterization and monitoring; environmental transport processes; health effects; ecological effects; and integrated assessment. This report is the compilations of proceedings from the review session.

45390 (PB—288406) **Microbial degradation of petroleum hydrocarbons.** Westlake, D.W.S.; Cook, F.D.; Johnson, A.M. (Alberta Univ., Edmonton (Canada); Research Council of Alberta, Edmonton (Canada)). Jul 1978. 79p. NTIS PC A05/MF A01.

The responses to Prudhoe Bay oil of the microbial populations present in water column, beach and sediment samples representative of the diverse marine shoreline environments found in the northern Puget Sound and Juan de Fuca areas were investigated under laboratory conditions. All sites studied yielded psychrotrophic bacterial populations which, in the presence of added nitrogen and phosphorus, were able to bring about changes in the n-alkane components of Prudhoe Bay oil. Under laboratory conditions, apparently one-third of the weight of oil was lost by weathering, one-third lost by mineralization due to microbial activity and one-third left as a residue. No changes in Prudhoe Bay oil were observed with nitrogen and phosphorus being absent. Increasing the temperature of incubation resulted in a faster rate of disappearance of n-alkanes present in this oil. Samples from the water column environment showed the greatest seasonal variation in ability to modify Prudhoe Bay oil. Beach samples were quite constant in their ability to yield oil-degrading bacterial populations.

45391 (PNL—2850(Pt.2)) **Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.** Vaughan, B.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. Contract EY-76-C-06-1830. 166p. Dep. NTIS, PC A08/MF A01.

Ten of the eleven individual sections (and their subsections) were abstracted and indexed separately. In the section entitled Energy Research for Other Agencies, results of studies for the Nuclear Regulatory Commission, Bonneville Power Administration, Electric Power Research Institute, National Oceanic and Atmospheric Administration/Bureau of Land Management, and the National Institute of Environmental and Health Sciences are briefly summarized. (JGB)

45392 (PNL—2850(Pt.2), pp 4.5-4.12) **Long-term effects of hydrocarbons on selected ecosystems and associated organisms.** Anderson, J.W. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Progress is reported in research on the responses of various marine organisms to realistic concentrations of petroleum hydrocarbons in water for different exposure periods. This information will be used in a model for assessing the effects from oil inputs ranging from short-term spill situations to chronic releases. Methods of exposure and calculations of responses are designed to provide a statistically valid means of predicting the damage of inputs to marine species. Results of gas chromatographic analysis of clam tissue, oysters, and amphipods for various petroleum hydrocarbons are given. Toxicity indices of selected marine species are also tabulated.

45393 (PNL—2850(Pt.2), pp 6.3-6.7) **Sublethal effects of tritium on aquatic systems [and] effects of lithium and beryllium on aquatic systems [and] teratogenic effects of low-level magnetic fields.** Emery, R.M.; Strand, J.A. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Continuing studies of the sublethal effects of tritium on freshwater species are directed to determine the potential for genetic transmission of suppressed immune competence to offspring from parental rainbow trout (Salmo gairdneri) exposed to tritium oxide (0, 0.04, 0.4, 4.0, 40.0 rads) over embryogenesis. Another fusion-related research project focuses on the potential adverse effects of the metals lithium and beryllium on aquatic systems. Studies now under way include an evaluation of the potential toxicity of lithium on early life stages of the rainbow trout and the effects of lithium on Columbia River periphyton communities. Additional fusion-related research included assessment of effects of low-level magnetic fields on a representative vertebrate. Again, the embryological life stages of the rainbow trout are employed. Particular interest is in the immediate effects of inhibited fertilization, delayed or arrested development, and inhibition of hatching.

45394 (PNL—2850(Pt.2), pp 9.7-9.9) **Ecological effects of combined aquatic stressors.** Anderson, D.R.; Schneider, M.J. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

This program represents two major research areas which were formerly separate projects and are now combined under one program. The former was designed to measure thermal injury, latent and manifest, in fish and other organisms important in aquatic food chains. The latter uses such thermal data to investigate the toxicity of multiple pollutants, including thermal pollution and their combined effects on fish. A key concept emerging from these studies is that of synergistic effect; i.e., where several pollutants each, at sublethal concentrations, act together to cause significant abnormality or death. The use of the combined-effect approach in estimating the toxicity of effluents containing multiple toxicants is more realistic than a single-factor approach.

45395 (PNL—2850(Pt.2), pp 9.11-9.13) **Effects of energy systems effluents on coastal ecosystems.** Roesijadi, G.; Young, J.S. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Progress is reported in an investigation on the potential effects of contaminants released by energy technologies into the marine environment. The primary goal is to identify and evaluate environmentally meaningful measures of the effects which contaminants produced by energy systems have on marine organisms. In the past year the effects of two classes of contaminants released by energy technologies, biocides and trace metals (represented by chlorine and copper, respectively), on aspects of the physiology, biochemistry, and histology of selected marine animals were studied.

45396 (PNL—2850(Pt.2), pp 9.15-9.18) **Bioavailability of energy effluent materials in coastal ecosystems.** Crecelius, E.A.; Gibson, C.I.; Kannberg, L.D.; Rogers, J.E.; Schmidt, R.L. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The bioavailability program attempts to provide an understanding of the processes involved in the cycling of materials resulting from energy technologies in the marine coastal ecosystem. The primary goal of the program is to be able to predict the fate and ultimate ecological consequences of materials produced by energy technology in the coastal ecosystem. Copper was selected for study because it corrodes in seawater and is a frequent pollutant of marine ecosystems via mining operations, copper paint on ships, copper tubing from power plants, and other sources. Progress is reported in work on the development of a method for accurately measuring the bioavailable fraction of a contaminant in the marine ecosystem and determination of how natural changes and those induced by energy technology effect the quantities of bioavailable contaminants in the aquatic ecosystem. Results of studies on the body burdens of three marine species exposed to aged and unaged seawater solutions of copper are reported. (JGB)

45397 (PNL—2850(Pt.2), pp 9.19-9.23) **Marine chemisty of energy-generated pollutants [and] in situ pollutants.** Crecelius, E.A.; Robertson, D.E.; Abel, K.H.; Wogman, N.A. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

This program is designed to increase our understanding of the biogeochemical and physical processes that control the fate of energy-generated pollutants that enter the marine environment. Specific tasks that were accomplished during the last year include determining the solubility of airborne particulates in seawater, shipboard analysis of mercury in seawater by a new, more sensitive technique and analysis of trace elements in coastal and oceanic waters. Progress is also reported in studies on the in-situ analysis of the wide spectrum of inorganic, organic, and radionuclide species in ocean and freshwater sediments. Of particular interest this year is sediment analysis by x-ray fluorescence.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 45339, 45359, 45363, 45373, 45374, 45380, 45391, 45393, 45407

45398 (CONF-790602—64) **Chemical factors controlling actinide sorption in the environment.** Beall, G.W.; Allard, B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The solid geologic media and the aqueous phase are of equal importance for the retention of actinides in the environment. The composition of the water is largely determined by the mineralogical composition of the rock that it is in equilibrium with. The chemical form of the actinides and their sorption, are highly dependent on the composition of the water with respect to pH, redox potential, and concentration of anions like carbonate, phosphate, fluoride, and organic acids.

45399 (FERMILAB—79/26) **Environmental monitoring report for calendar year 1978.** Baker, S.I. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 May 1979. Contract EY-76-C-02-3000. 58p. Dep. NTIS, PC A04/MF A01.

The accelerator operated routinely at 400 GeV during CY-1978 with about the same number of protons during CY-1978 as in CY-1977. The total number of protons accelerated in 1978 was 2.1 x 10^{19}. The maximum number of protons accelerated at one time exceeded half of the planned or design intensity of 5 x 10^{13} protons per acceleration cycle and typical operation was at about 40% of the design intensity. During CY-1978 there was one abnormal occurrence which had an impact on the facility and its operation. On September 13 a rainfall of 15.5 cm (6.1 in.) occurred with the bulk of it falling in less than three hours before dawn. An associated lengthy and extensive power outage resulted in inoperative sump pumps which led to the flooding of some underground enclosures. The damage estimate was $140,000, primarily for repair of magnets, transformers and other electrical equipment. A new ponding system was in operation throughout CY-1978, eliminating the use of chromates. The concentration of chromates in on-site waters was negligible in CY-1978. Copper from regeneration of resins at the BO Water Treatment Plant continues to surface. The surfacing was at a reduced rate in CY-1978 and the copper concentration in the C4 pond which receives this discharge was well below the State of Illinois standard for waters in general use. The total potential radiation exposures at the point of highest dose rate at the site boundary and to the general off-site population from Fermilab operations during CY-1978 were 11 mrem and 5 man-rem, respectively, compared to 7 mrem and 3 man-rem, respectively, last year. The site boundary dose rate is higher because the experimental area produced more off-site muons this year. The potential dose at the site boundary corresponds to 2.2% of the standard of 500 mrem for an individual who is not a radiation worker. It is primarily from muons.

WATER

REFER ALSO TO CITATION(S) 45450

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 45361, 45362

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 45361, 45362, 45366, 45402, 45454

45400 (PB—287887) **Enhanced hydrodynamical-numerical model for near-shore processes. Final report 1975-1977.** Bauer, R.A.; Stroud, A.D. (Compass Systems, Inc., San Diego, CA (USA)). Jul 1978. Contract EPA-68-03-2225. 70p. NTIS PC A04/MF A01.

An optimized version of a multilayer Hansen type Hydrodynamical-Numerical (HN) model is presented and discussed here as the basis for the following experimental extensions and enhancements developed to more appropriately handle near-shore processes: Nonlinear term extension to facilitate small-mesh studies of near-shore, including river inflow dynamics; Layer disappearance extension to enable appropriate procedures in tidal flat and marshy regions, as well as some down/upwelling cases; Thermal advection enhancement for treatment of thermal pollution cases by method of moments coupled with heat budget procedures for dynamic plume development experiments; Monte Carlo diffusion enhancement to deal with dispersion via statistical methods and comparison to the method of moments experiments. Extensive efforts were invested in determining reasonable and appropriate boundary conditions for both the basic model and the extended versions presented here.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 44249, 44258, 44728, 45381

45401 (PNL—2850(Pt.2), pp 7.3-7.4) **Effects of hydroelectric generation on Riverine ecology.** Becker, C.D.; Fickeisen, D.H.; Gray, R.H.; Montgomery, J.C. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Investigations continued on the effects of short-term fluctuations in water level below hydroelectric facilities. These investigations emphasized quantifying the impact of entrapment on salmonid fry, subsequent salmonid fry mortality, impacts on smallmouth bass (Micropterus dolomieui) reproduction caused by fluctuations in temperature and water level in their spawning areas, and entrapment of bass fry. Adult bass movements were studied by dart-tagging and soliciting tag returns from fishermen. Mark-recapture experiments and fishing along standard transects were used to estimate the population size and relative abundance of fish species in impacted inshore areas.

REGULATIONS

45402 (PB—287863) **Federal Water Pollution Control Act: the sections 316(a) and (b) process. Topical briefs report.** Fritz, E.S. (National Plant Power Team, Ann Arbor, MI (USA)). Aug 1978. 20p. NTIS PC A02/MF A01.

A description of those sections of the Federal Water Pollution Control Act Amendments of 1972 pertaining to thermal discharges and steam electric power plants is presented. Implementation of Sections 316(a) and (b) of the Act is discussed along with the relationship between 316(a) Demonstrations and 316(b) Studies. The adjudication process and the role of the Fish and Wildlife Service in implementing the Act are outlined.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 44478, 44962

45403 (PB—288602) **Environmental assessment data base for high-Btu gasification technology. Volume I. Technical discussion. Final report Jun 1977—Aug 1978.** Ghassemi, M.; Crawford, K.; Quinlivan, S. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Sep 1978. Contract EPA-68-02-2635. 172p. NTIS PC A08/MF A01.

The report is part of a comprehensive EPA program for the environmental assessment (EA) of high-Btu gasification technology. It summarizes and analyzes the existing data base for the EA of technology and identifies limitations of available data. Results of the data base analysis indicate that there currently are insufficient data for comprehensive EA. The data are limited since: (1) there are no integrated plants, (2) some of the pilot plant data are not applicable to commercial operations, (3) available pilot plant data are generally not very comprehensive in that not all streams and constituents/parameters of environmental interest are addressed, (4) there is a lack of experience with control processes/equipment in high-Btu gasification service, and (5) toxicological and ecological implications of constituents in high-Btu gasification waste streams are not established. A number of programs are currently underway or planned which should generate some of the needed data. The report consists of three volumes: Volume I summarizes and analyzes the data base.

45404 (PB—288603) **Environmental assessment data base for high-Btu gasification technology. Volume II. Appendices a, b, and c. Final report Jun 1977—Aug 1978.** Ghassemi, M.; Crawford, K.; Quinlivan, S. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Sep 1978. Contract EPA-68-02-2635. 415p. NTIS PC A18/MF A01.

The report is part of a comprehensive EPA program for the environmental assessment (EA) of high-Btu gasification technology. It summarizes and analyzes the existing data base for the EA of technology and identifies limitations of available data. Results of the data base analysis indicate that there currently are insufficient data for comprehensive EA. The data are limited since: (1) there are no integrated plants, (2) some of the pilot plant data are not applicable to commercial operations, (3) available pilot plant data are generally not very comprehensive in that not all streams and constituents/parameters of environmental interest are addressed, (4) there is a lack of experience with control processes/equipment in high-Btu gasification service, and (5) toxicological and ecological implications of constituents in high-Btu gasification waste streams are not established. A number of programs are currently under way or planned which should generate some of the needed data. The report consists of three volumes of which Volume II contains data sheets on gasification, gas purification, and gas upgrading.

45405 (PB—288604) **Environmental assessment data base for high-Btu gasification technology. Volume III. Appendices d, e, and f. Final report Jun 1977—Aug 1978.** Ghassemi, M.; Crawford, K.; Quinlivan, S. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Sep 1978. Contract EPA-68-02-2635. 342p. NTIS PC A15/MF A01.

The report is part of a comprehensive EPA program for the environmental assessment (EA) of high-Btu gasification technology. It summarizes and analyzes the existing data base for the EA of technology and identifies limitations of available data. Results of the data base analysis indicate that there currently are insufficient data for comprehensive EA. The data are limited since: (1) there are no integrated plants, (2) some of the pilot plant data are not applicable to commercial operations, (3) available pilot plant data are generally not very comprehensive in that not all streams and constituents/parameters of environmental interest are addressed, (4) there is a lack of experience with control processes/equipment in high-Btu gasification service, and (5) toxicological and ecological implications of constituents in high-Btu gasification waste streams are not established. A number of programs are currently under way or planned which should generate some of the needed data. The report consists of three volumes of which Volume III contains data sheets on air and water pollution control and on solid waste management.

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 44262, 44319, 44320, 44321, 44322, 44323, 44324

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 44885, 44930, 45389

45406 (PNL—2850(Pt.2), pp 9.3-9.5) **Analysis of natural systems.** Eberhardt, L.L.; Thomas, J.M. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The thrust of this project has continued to be development of quantitative theory and improved methods for application to real-world problems. Emphasis is placed on the improvement of sampling methods through the application of sampling theory and new statistical techniques. (JGB)

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 44884, 44913

45407 (PB—286974) **Occidental Chemical Company Swift Creek Chemical Complex, Hamilton County, Florida. Final environmental impact statement.** (Environmental Protection Agency, Atlanta, GA (USA). Region IV). Sep 1978. 371p. NTIS PC A16/MF A01.

This Final EIS concerns the issuance of an NPDES permit to Occidental Chemical Company for the construction of a new chemical plant in Hamilton County, Florida. The construction of the new Swift Creek Chemical Complex is part of a two-phased plan to increase the superphosphoric acid capacity of the north Florida phosphate fertilizer manufacturing complex. The Final EIS summarizes the Draft EIS and addresses comments received by interested governmental agencies, environmental groups, and concerned citizens.

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 44725, 44727, 44728, 45470

45408 (COO—1332-130) **Vertebrate behavior and ecology. Progress report, July 1, 1977—June 30, 1978.** Tester, J.R.; Siniff, D.B. (Minnesota Univ., Minneapolis (USA)). Jul 1978. Contract EY-76-C-02-1332. 44p. Dep. NTIS, PC A03/MF A01.

Progress is reported in the following research projects: use of radiotelemetry to study vertebrate populations and censuring; evaluation of census methods; development of a small transmitter and immobilizing drugs for studies on sea otters; telemetry study of migratory behavior of pronghorn antelope at INEL site; use of pressure sensitive depth transmitters for studies on effect of gas super-saturated water on behavior of migratory salmon; and interspecific relations among tree squirrels. (HLW)

45409 **Behavior and ecology of wolves.** Klinghammer, E. (ed.). New York, NY; Garland STPM Press (1979). 605p. (CONF-7505153—).

From Symposium on the behavior and ecology of wolves; Wilmington, NC, USA (23 May 1975).

Part I of the book contains five chapters on wolves in the wild. Discussions are presented of the ecology of wolves in Glacier National Park, Isle Royal in Lake Superior, Canada, Finland, and other European countries. Part II contains eight chapters on analysis of behavior. Topics discussed are territoriality, daily howl records, wolf pack genetics, dominance, and individual variability. Part III contains eight chapters on translocation and reintroduction. The role of public opinion in wolf management and law enforcement are considered. Part IV contains two chapters on wolves in captivity. A data bank for captive wolves is described. Part V contains two chapters on the red wolf. A study of movements and activity of red wolves in Chambers County, Texas, was conducted using radio location telemetry. The red wolf as an endangered species is discussed and recommendations for its recovery are given. (HLW)

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 45172, 45390, 45430

45410 (BNL—25550) **Processing of bacteriophage T7 RNAs by RNase III.** Studier, F.W.; Dunn, J.J.; Buzash-Pollert, E. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790152—1). Dep. NTIS, PC A02/MF A01.

From Miami winter symposia; Miami, FL, USA (8 Jan 1979).

T7 messenger RNAs are produced by RNase III cleavages of the primary transcripts. Analysis of the nucleotide sequences around the five points of cleavage in T7 early RNA, together with the effects of mutations on cleavage, suggests that efficient cleavage by RNase III may require a particular structure in the RNA. The proteins specified by most T7 messenger RNAs seem to be made about equally well whether or not the RNAs have been cut by RNase III. An exception is the gene 0.3 protein, which is made in much greater amounts if the messenger RNA has been cut. If the attached RNA to the 5′ side is not removed by RNase III cleavage, it interferes with ribosome binding at the initiation site for the 0.3 protein, probably by base pairing to a sequence in the 0.3 RNA that needs to be free to interact with the ribosome. Synthesis of the gene 0.4 protein, also specified by the 0.3 RNA, is unaffected by cleavage. The effect of RNase III cleavage on synthesis of 0.3 protein provides an example of specific control of translation by modification of the messenger RNA, although T7 does not appear to use this mechanism to control synthesis of 0.3 protein during a normal infection.

45411 (CONF-790235—1) **Pyrimidine biosynthesis in normal and transformed cells.** Uziel, M.; Selkirk, J.K. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

From ICN-UCLA symposium; Keystone, CO, USA (25 Feb 1979).

We have developed procedures for sensitive measurement of specific raioactivities of pyrimidine nucleosides excreted from cells in culture. The changes in the observed values reflect dilution of the added isotope through de novo biosynthesis of nonradioactive pyrimidine nucleosides or by shifting and equilibration of other nucleotide pools into the free uridine pool. It is thus possible to monitor uridine biosynthesis occurring in intact cells without destroying or disrupting the cell population. On comparing a series of normal and transformed lines, we have observed several growth dependent patterns of change in specific activity and levels of uridine excretion and the temporal appearance of these changes. Hamster embryo fibroblasts cease pyrimidine biosynthesis at mid-growth while hamster cell line V79 continues to dilute the pyrimidine pool at about 7% of the rate observed during exponential growth at confluence. Both cells exhibit Urd excretion beginning at one-half maximal growth. Passageable normal rat liver cells (IARC-20) also show a cessation of pyrimidine biosynthesis with a prior increase in uridine excretion.

45412 **Analytical techniques for cell fractions. XXIII. A stable thermal gradient device for heat denaturation studies on proteins.** Anderson, N.L.; Eisler, W.J.; Anderson, N.G. (Argonne National Lab., IL). *Anal. Biochem.;* **91**: No. 2, 441-445(Dec 1978).

The ISO-DALT two-dimensional electrophoretic system, based on the method of O'Farrell, is capable of performing large numbers of analyses on complex mixtures of proteins. However, both separations employed are carried out under dissociating or denaturing conditions and no enzyme activities are readily observable in the analyzed proteins. In order to identify the spots corresponding to particular enzymes, it is therefore necessary to employ some nondestructive resolving technique first and as a second step to perform both enzyme and two-dimensional electrophoretic analyses on the fractions generated. By correlating enzyme activity with intensity of various spots on the two-dimensional gels throughout the series of initial fractions, identifications can be made. This approach, unlike the more direct immunoprecipitation methods, requires the running of large numbers of enzyme analyses and two-dimensional gels and some convenient initial resolving procedure. Convenient and rapid techniques for the analyses and gels have been described previously in this series and elsewhere. This paper deals with the use of selective denaturation in a temperature gradient as an initial resolving procedure and describes a simple thermal gradient device for generating such a gradient.

45413 (LBL—9065) **Activation and covalent binding of a chemical carcinogen to DNA.** Straub, K.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 211p. Dep. NTIS, PC A10/MF A01.

Thesis.

The activation and covalent binding to DNA of a widespread environmental carcinogen, benzo(a)pyrene (BaP, structure 1) were studied. An in vitro DNA-binding assay based on purified rat liver microsomes was used to isolate the bound carcinogen-nucleic acid complex. The products of this reaction were studied by fluorescence spectroscopy and allowed identification of the activated hydrocarbon as a 7,8-dihydroxy-7,8,9,10-tetrahydrobenzo(a)pyrene. These results, along with current literature studies on the metabolism of benzo(a)pyrene and on the mutagenic activity of its metabolites suggested the identity of the active form as a 7,8-dihydroxy-9,10-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene (BaP-diol epoxide, structure II). This material was synthesized and reacted with a variety of DNA's (calf thymus, SV40, OX174) in vitro; the products were observed to be chromatographically identical to the hydrocarbon-nucleoside adducts obtained from microsomal enzyme-mediated binding of benzo(a)pyrene to DNA.

45414 (UCRL—82653) **Analysis of temperature-sensitive mutants and the use of purine analog resistance in CHO cells.** Thompson, L.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 May 1979. Contract W-7405-ENG-48. 26p. (CONF-790537—5). Dep. NTIS, PC A03/MF A01.

From Cold Spring Harbor symposium on quantitative mammalian cell mutagenesis and mutagen screening; Cold Springs Harbor, NY, USA (6 May 1979).

This paper summarizes the results of an analysis of TS mutations in the structural gene loci of the aminoacyl-tRNA synthetases (aaRSs) in near-diploid Chinese hamster ovary (CHO) cells. After treating with chemicals that produce missense mutations and using a selection procedure that is highly specific for these kinds of mutants,

we obtained conditional mutants for 7 of the 20 aaRSs. Altered temperature sensitivity of the enzymes in several of these mutants and revertants derived from them were demonstated.

45415 (UR—3490-1580) **Energy transduction between the catalytic and ionophoric sites of Ca^{2+} + Mg^{2+}-ATPase molecule.** Shamoo, A.E.; Herrmann, T.; Abramson, J.J.; Murphy, T. (Rochester Univ., NY (USA). School of Medicine and Dentistry). 1979. Contract EY-76-C-02-3490. 9p. (CONF-790452—1). Dep. NTIS, PC A02/MF A01.

From International symposium on function and molecular aspects of biomembrane transport; Bari, Italy (23 Apr 1979).

Our data have shown that the intact sarcoplasmic reticulum (SR) Ca^{2+} + Mg^{2+}-ATPase molecule contains the Ca^{2+}-conducting pathway (Ca^{2+}-ionophorous property) as an integral part of the enzyme molecule. Furthermore, we have shown that controlled tryptic digestion of the enzyme results first in the production of 55,000 (A) and 45,000 (B) dalton fragments followed by a further cleavage of the 55°K fragment into 30,000 (A_1) and 20,000 (A_2) dalton fragments. Digestion of the 55°K dalton fragment into 20°K and 30°K dalton fragments results in inhibition of calcium transport in SR vesicles, but does not affect ATPase activity. This is consistent with disruption of energy transduction between the hydrolytic site (30°K) and the ionophoric site (20°K). It was also shown that the 55°K (A_1) and 20°K (A_2) have ionophorous activity similar to that of the intact enzyme, and that the 45°K dalton fragment has nonselective channel-like activity. The 20°K (A_2) fragment possesses Ca^{2+} ionophorous properties in phosphatidylcholine vesicles similar to those observed in black lipid membranes.

45416 Relationship between histidyl-tRNA level and protein synthesis rate in wild-type and mutant Chinese hamster ovary cells. Lofgren, D.J.; Thompson, L.H. (Lawrence Livermore Lab., CA). *J. Cell. Physiol.;* **99**: No. 3, 303-312(Jun 1979).

A preliminary investigation was carried out to determine how conditional lethal mutants affected in particular aminoacyl-tRNA synthetases may be used to study the role of tRNA charging levels in protein synthesis. The ovary cells relationship between rate of protein synthesis and level of histidyl-tRNA in wild-type cultured Chinese hamster was determined using the analogue histidinol to inhibit histidyl-tRNA synthetase activity. This response was compared with that obtained using a mutant strain with a detective histidyl-tRNA synthetase that phenotypically shows decreased rates of protein synthesis at reduced concentrations of histidine in the growth medium. The approach used was based on measuring the histidyl-tRNA levels in live cells. The percentage charging was estimated by comparing [^{14}C]histidine incorporated into alkali-labile material in paired samples, one of which was treated with cycloheximide, five minutes before terminating during the incubation, to produce maximal aminoacylation. Wild-type cells under histidinol inhibition exhibited a sensitive, sigmoidal relationship between the level of histidyl-tRNA and the rate of protein synthesis. A decrease in the relative percentage of acylated tRNA/sup His/ from 46% to 35% elicited a large reduction in the rate of protein synthesis from 90% to 30% relative to untreated cells. An unpredicted result was that the relationship between protein synthesis and histidyl-tRNA in the mutant was essentially linear. High acylation valuesfor tRNA/sup His/ were associated with rates of protein synthesis that were not nearly as high as in wild-type cells.

45417 Uptake of circular deoxyribonucleic acid and mechanism of deoxyribonucleic acid transport in genetic transformation of Streptococcus pneumoniae. Lacks, S. (Brookhaven National Lab., Upton, NY). *J. Bacteriol.;* **138**: No. 2, 404-409(May 1979).

Deoxyribonucleic acid (DNA) from the covalently closed circular DNA molecules of Pseudomonas phage PM2 was found to enter normally transformable cells of Streptococcus pneumoniae as readily as linear bacterial DNA. In a mutant of S. pneumoniae that lacks a membrane nuclease and is defective in DNA entry, as many molecules of PM2 DNA as of linear DNA were bound on the outside of cells at equivalent DNA concentrations. Bound DNA suffered single-strand breaks, but circular DNA with preexisting breaks was bound to better than closed circles. In the presence of divalent cations, DNA bound to cells of a leaky nuclease mutant showed double-strand breaks. At least the majority of PM2 DNA that entered normal cells was single stranded. These results are consistent with a mechanism for DNA entry in which DNA is first nicked on binding, then a double-strand break is formed by cleavage of the complementary strand, and continued processive action of the membrane nuclease facilitates entry of the originally nicked strand. Although the bulk of circular donor DNA appeared to enter in this way, the results do not exclude entry of a small amount of donor DNA in an intact form.

45418 (UR—3490-1259) **Preparation and spectroscopic characterization of molecular species of brain phosphatidylserines.** Salem, N. Jr.; Serpentino, P.; Puskin, J.S.; Abood, L.G. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics; National Inst. of Neurological Diseases and Stroke, Bethesda, MD (USA)). [nd]. Contract EY-76-C-02-3490. 42p. Dep. NTIS, PC A03/MF A01.

This study describes the first preparation and spectroscopic characterization of naturally occurring phospholipids separated according to degree of unsaturation. Phosphatidylserines (PS) have been prepared from bovine brain and shown to be pure by extensive thin layer chromatographic analysis as well as by infrared spectroscopy and fatty acid analysis. The PS has been separated according to degree of unsaturation and prepared using $AgNO_3$- impregnated silica gel H thin layer chromatography. Fatty acid analysis of the two principal PS subfractions indicates that they are enriched in the molecular species 1-octadecanoyl-2-docosahexaenoyl-sn-glycero-3-phosphorylserine and 1-octadecanoyl-2-octadecenoyl-sn-glycero-3-phosphorylserine. The identity of the two PS subfractions was further verified by rechromatographing on several thin layer systems and by infrared spectroscopy.

CYTOLOGY

45419 Application of flow cytometry and cell sorting to megakaryocytopoiesis. Nakeff, A.; Valeriote, F.; Gray, J.W.; Grabske, R.J. (Washington Univ., St. Louis, MO). *Blood;* **53**: No. 4, 732-745(Apr 1979).

We have employed flow cytometry (FCM) and cell sorting to quantitate and study megakaryocytes in mouse and rat femoral marrow following their 20- to 30-fold concentration by centrifugal elutriation (CE). This enrichment of megakaryocytes permitted the first determination of their DNA-related fluorescence by FCM analysis following DNA staining. Fluorescence distributions of CE-enriched cell fractions following supravital staining with Hoechst 33342 were similar to those following chromomycin A3 staining of ethanol-fixed cells. Microscopic examination of cells sorted onto glass slides on the basis of their DNA-related fluorescence following supravital staining together with specific acetylcholinesterase staining for megakaryocytes indicated that megakaryocytes generally increased in cell size with increasing DNA content. This technologic application represents a significant advance in the study of megakaryocytopoiesis, since the kinetics of either the normal or perturbed population can now be studied rapidly and quantitatively.

GENETICS

REFER ALSO TO CITATION(S) 45388, 45414, 45417

45420 (DOE/EV/71005—48) **Theoretical studies of gene substitution, geographic variation, and speeciation. Annual progress report, July 1977—October 1978.** Felsenstein, J. (Washington Univ., Seattle (USA). Dept. of Genetics). Oct 1978. Contract EY-76-S-06-2225-005. 15p. (RLO—2225-5-48). Dep. NTIS, PC A02/MF A01.

Progress is reported on the following studies: macroevolution; multivariate normal models; inconsistency of the parsimony method; alternative parsimony methods; isolation by distance; kin selection; disruptive selection; evolution of cooperation; genetic mapping; speciation; theoretical population genetics; and methods of traversing pedigrees. (HLW)

45421 (RLO—2225-5-44) **Theoretical studies of gene substitution, geographic variation, and speciation.** Felsenstein, J. (Washington Univ., Seattle (USA). Dept. of Genetics). 15 Apr 1978. Contract EY-76-S-06-2225-005. 6p. Dep. NTIS, PC A02/MF A01.

Work is being carried out on a variety of projects in theoretical population genetics, their common theme being a concern with macroevolutionary processes, the evolution of ecosystems, and speciation. Models of speciation based on natural selection of quantitative characters will be constructed, with the object of finding conditions under which speciation is not expected to occur (it being easy to find conditions under which it will occur). A model for macroevolution of a model ecosystem has also been developed, for which it has proved possible to obtain macroevolutionary laws and a possible relationship between entropy production and increase of biological adaptive information content. This model will in the near future be further generalized in a number of ways. A variety of other projects are also under way. One of the most important is the maintenance and expansion of the Bibliography of Theoretical Population Genetics, with a view toward publication in the near future. Other current projects involve development of practical numerical methods for estimation of evolutionary trees from DNA and protein sequency data, and testing hypotheses about the constancy of the rate of gene substitution from this data. Another project involved finding methods for estimating patterns of migration (parameters of migration matrices) from data on genetic distances between populations. This will be of particular interest as a building-block toward a test of th neutral mutation hypothesis of genetic variation.

45422 Mutation of the non-Mendelian suppressor, psi$^+$, in yeast by hypertonic media. Singh, A.; Helms, C.; Sherman, F. (Univ. of Rochester, New York). *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 4, 1952-1956(Apr 1979).

The psi$^+$ extrachromosomal determinant in the yeast Saccharomyces cerevisiae suppresses certain UAA markers and increases the efficiency of suppression of UAA suppressors and certain frameshift suppressors. Although the exact nature of psi$^+$ determinant is unknown, it is believed to be a self-replicating cytoplasmic factor affecting some component of the translational machinery. In this report we describe growth conditions for efficient mutation or elimination of the psi$^+$ determinant. Incubation of psi$^+$ cultures in hypertonic nutrient medium resulted in rapid conversion to a culture containing predominantly psi$^-$ cells during the growth cycle. The kinetics of psi$^+$ to psi$^-$ conversion established that the occurrence of psi$^-$ cells was due to induction and not to selection of pre-existing psi$^-$ cells. The results suggest that the replication of the psi$^+$ determinant is sensitive to hypertonic conditions.

45423 Stochastic models for the evolution of multigene families. Perelson, A.S. *Rocky Mt. J. Math.;* 9: No. 1, 115-130(Jan 1979).

The process of coincidental evolution is explained by means of the "homologous but unequal crossing-over" model. (AIP)

METABOLISM

TRACER TECHNIQUES

45424 (N—78-29731) **Milk secretion of ^{65}Zn in the goat after oral intake of radiozinc.** Ekman, L.; Jones, B.E.V. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1977. 16p. NTIS PC A02/MF A01.

The metabolism of Zn-65 was studied in seven lactating goats after the administration of 100 to 200 muCi Zn65Cl solution. In blood and milk, Zn-65 was detected 4 hours after the administration of the radionuclide. Maximum blood concentration was reached after about 24 hr and in milk after about 48 hr. At this time the concentration was about 0.5% per liter plasma or milk. The milk secretion of Zn-65 accumulated during 7 days varied considerably. The three goats receiving 40 mg a day of dietary zinc secreted 2.7% to 5.8% of the given amount of Zn-65, and the goats receiving 200 mg of stable zinc daily secreted only 0.3% to 0.9%. The accumulated urinary and fecal excretion showed less variation. The four animals studied excreted less than 0.2% in the urine and 65.1% to 91.4% of the given amount in the feces. The concentration of stable zinc ranged from 690 to 1070 mg per liter plasma and from 680 to 1430 mg per liter milk.

45425 (N—78-29732) **Metabolism of ^{181}W-labeled sodium tungstate in goats.** Ekman, L.; Figueiras, H.D.; Jones, B.E.V.; Myamoto, S. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1977. 20p. NTIS PC A02/MF A01.

The metabolism of 181-W labeled Na2WO4 in goats was studied because tungsten radionuclides have been detected in fallout in several countries. It was found that a minor part of the ingested 181-W was absorbed in the gastrointestinal tract, the main part, about 95%, was recovered in the feces. The absorbed radiotungsten was mainly in the urine (1.8% to 3.4%) and a small amount was recovered in the milk (0.03% to 0.12%). On autopsy the largest amounts of 181-W were found in the kidneys and liver but large amounts were also found in ribs and some lymph nodes. About 87% was excreted in the urine, 6% in feces and 3% in milk 48 hr after intravenous injection. Intravenous administration was found to give 15 to 20 times higher radioactivity concentration than oral administration. The data obtained suggest that radiotungsten is unlikely to be a significant environmental pollutant source for man as far as its concentration in milk and meat are concerned.

MEDICINE

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 45301, 45452

EXTERNAL RADIATION IN DIAGNOSTICS

45426 (HRP—0900242) **Planning guide for radiologic installations -- fascicle 5, pediatric facilities.** Tuddenham, W.J. (American Coll. of Radiology, Chicago, IL. Committee on Dept. Planning). 1977. 109p. American College of Radiology, 6900 Wisconsin Ave., Chevy Chase, MD 20015.

The Committee on Department Planning of the Commission on Radiologic Equipment and Facilities has prepared this collection of articles to aid radiologists, architects and engineers in developing plans for a department of pediatric radiology, whether it is a new facility or one to be remodeled. The document contains five articles reflecting several viewpoints on the importance of pediatric radiology as a separate department, the physical layout of such a department, equipment specifications, contract handling, and cost limitations. Each article is a review of the facilities for pediatric radiology in a different institution, a review of the rationale on installation of the equipment used, problems encountered in facilities installation, organizational and procedural systems used for efficient use and patient flow, and some special considerations necessary for space and design and procedures and precautions necessary in a pediatric radiology facility. Considerations for location of clinical personnel, patient files, reading rooms and other ancillary facilities are also discussed. References are included within each article. Layout plans and other schema are also included.

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 45441

UNSEALED RADIONUCLIDES IN THERAPY

REFER ALSO TO CITATION(S) 45441

MICROBIOLOGY

REFER ALSO TO CITATION(S) 45349, 45370, 45378, 45390

MORPHOLOGY

45427 (COO—2987-1) **Center for Biosystematics Resources. Final report.** (Association of Systematics Collections Information Center, Lawrence, KS (USA)). [nd]. Contract EY-76-C-02-2987. 18p. Dep. NTIS, PC A02/MF A01.

The Association's Registry currently contains data on 682 biological collections and approximately 1300 individuals. During the past year, the Association has responded to a number of inquiries for names of biologists and/or curators to provide needed services. A promotional brochure for the Registry was published and distributed to over 6,000 individuals. Three seminars were presented, providing information about, and a demonstration of, the Registry. These seminars were particularly effective in communicating the importance and availability of the services that are available through the Association. Independently, the Association also has provided informational services to biologists on federal permit requirements to acquire, transport, and maintain biological specimens. State agencies have provided copies of analogous state regulations. While the data are now accumulated, they are not readily available to inquirers outside the office. The current contract would insure that the information on state regulations would be computerized and made generally available. Further, the Association has begun to accumulate a variety of species lists which could be of value to the Department of Energy.

PATHOLOGY

REFER ALSO TO CITATION(S) 45468

45428 Hairy cell leukemia: an autopsy study. Vardiman, J.W. (Univ. of Chicago Hospitals and Clinics, IL); Variakojis, D.; Golomb, H.M. Contract EY-76-C-02-0069. *Cancer;* **43**: No. 4, 1339-1349(Apr 1979).

Autopsy material from 5 patients with hairy cell leukemia was examined. In addition to the expected widespread involvement of the hematopoietic system and of the liver, all of the patients had various amounts of pulmonary infiltration by leukemic cells. This infiltration was so severe in one instance that the resulting pulmonary insufficiency was the cause of death. Other areas of hairy cell infiltration included the peripancreatic connective tissue in all cases, kidneys in 3 cases, pericardium in 2 cases, and skin in 1 case. Association of plasma cells with the infiltrating neoplastic cells was prominent. In one patient, foci of large, bizarre cells were found in several lymph nodes and in the pericardium. Whether these cells represent transformation of the hair cells into a larger, less differentiated cell type, or the emergence of a second hematopoietic neoplasm, is unknown.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 45431, 45457

45429 (ANL-Trans—1161) **Ventilation in the nasal sinuses.** Nagoshi, Y.; Usui, N.; Unoki, S.; Ishizuka, Y.; Yamaguchi, O.; Kawagami, H. Translated from *Jibi Inko-ka;* **42**: No. 6, 409-419(Jun 1970). 34p. Dep. NTIS, PC A03/MF A01.

With each respiration interchange of air occur between the sinus cavity and that of the nasal. The course with which this interchange takes place has been reported elsewhere. Anatomically, the size of the natural ostium plays an important role in the mechanism of this air-interchange. Experimentally, the size of the natural ostium and the corresponding changes of air pressure that may occur within the sinus cavity have been studied. Normally, when the natural ostium has an opening of 4 mm in diameter the intra-sinus air pressure would amount to about +- 6 mmH_2O. These tests have been repeatedly conducted also on cadavers and confirmed by using smoke as indicator.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 45433, 45442, 45443

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 45456, 45457

45430 (DOE/SR/01061—1) **Nitrogen fixation in forested soils by non-leguminous nitrogen-fixing plants and by non-symbiotic soil organisms. Progress report.** Lane, C.L. (Clemson Univ., SC (USA). Dept. of Forestry). Mar 1979. Contract EW-78-S-09-1061. 13p. Dep. NTIS, PC A02/MF A01.

Seeds and seedlings of 48 species of non-leguminous nitrogen-fixing species have been obtained. These have been planted in the greehouse and will be transplanted to the arboretum for long-term studies and seed production and to the field for survival, growth, and nitrogen-fixation studies. Field plantings of several species were made in the Spring of 1978 and measured after the first growing season. They were mixed plantings with loblolly pine. Survival was: black alder (Alnus glutinosa) 50%; hazel alder (Alnus serrulata) 32%; white alder (Alnus incana) 04%; thorny eleagnus (Eleagnus pungens) 98%; wax myrtle (Myrica cerifera) 42%; loblolly pine (Pinus taeda) 73%. The nutrient contribution to the soil of Alnus serrulata, Myrica cerifera, and Juniperous virginiana were also determined.

45431 (LA—7810-MS) **Experiments with radiotelemetry for monitoring body temperatures in cattle.** Seawright, G.L.; Sanders, W.M.; Payne, R.W.; Araki, C.T.; Levings, R.L. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

A multiple-animal temperature telemetry system was developed as an aid for studying stress and disease in unrestrained cattle. Cattle are instrumented with pulse-interval modulated transmitters operating in the 148- to 150-MHz range. The transmitter is fixed to the ear pinna. The receiver is a modified commercial scanner with selectable antennae. Up to 10 animals can be monitored simultaneously. The system has been used for multiple body-site temperature monitoring experiments and for evaluating the safety and efficacy of viral vaccines in cattle. Results of experiments in calves experimentally infected with bovine virus diarrhea (BVD) virus indicated that the shape and amplitude of subdermal fever responses were in close agreement with deep body temperatures. An experiment done in cattle vaccinated with injectious bovine rhinotracheitis virus and then challenged with a virulent field strain indicated that remote temperature monitoring has good potential as a tool for evaluating vaccine performance. The results show that temperature telemetry is a promising tool for evaluating vaccines and for studying disease in free-ranging cattle in their natural environments.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 45269

RADIATION EFFECTS ON BIOCHEMICALS

IN MAN

45432 (N—78-33710) **The preventive role of ultraviolet radiation during exposure to ionizing radiation.** Yatsula, G.S. Translated from *Gig. Sanit.;* No. 2, 48-52(Feb 1978). 9p. NTIS PC A02/MF A01.

The effect of suberythematous doses of ultraviolet and ionizing radiation on sulfhydryl groups, cholesterol and hemoglobin of the blood is studied.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

45433 (CONF-790447—4) **Combined effects of polycyclic aromatic hydrocarbons and sunlight.** Utsumi, H.; Lakas, G.R.; Elkind, M.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From Health implications of the new energy technologies; Park City, UT, USA (4 Apr 1979).

We have shown that Chinese hamster V79 cells are made photosensitive by dimethylbenzanthracene (DMBA) if the cells are treated with this PAH before, and not after, light exposure. The effective wavelengths are from ~ 290 to 400 nm. These wavelengths are present in natural sunlight reaching the earth's surface suggesting that PAH's generated by coal combustion processes may interact with sunlight to produce materials in the environment of a potentially toxic nature. In this regard we have also tested samples generated from a bench-scale pressurized fluidized bed coal combustion unit. These samples were either the fine particulates (fly ash) or the volatile organics which condense out at the end of the effluent stream. Both of these samples sensitized the mammalian cells to sunlight-simulating light as determined from cell survival measurements,, although to a lesser extent than the DMBA. In addition, the photosensitization was shown to be a true photodynamic effect. Since all three factors (i.e., PAH's, sunlight, and oxygen) necessary for the production of the phototoxic agent(s) would be expected to interact in the environment, the results may be of particular concern to human health. Both PAH's and sunlight are known carcinogens and their interaction may result in a potentiation of their carcinogenic activities. In addition the cytotoxicity produced could conceivably have a tumor promoting effect due to the resultant cellular repopulation. Our results have dealt with cell killing initially because it is the simplest and easiest endpoint of interest to measure. Additional studies ae in progress to studythe potential mutagenic and/or carcinogenic activities of combined PAH and sunlight exposure.

45434 (LBL—8850) **Degeneration and regeneration of the spermatogonial stem-cell system after exposure to ionizing radiation.** Fabrikant, J.I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., San Francisco (USA). Dept. of Radiology). Feb 1979. Contract W-7405-ENG-48. 27p. (CONF-790524—1). Dep. NTIS, PC A03/MF A01.

From 6. international congress symposium on radiation research and stem cells; Tokyo, Japan (13 May 1979).

Under continuous low level irradiation at 1.8 rad/day which will permit the survival of at least 10 generations in the mouse, cell renewal during spermatogenesis can achieve a near-steady state of cell population at ~ 80% of control levels for at least 12 cycles of spermatogonial cell renewal and 3 cycles of the seminiferous epithelium. Changes in the patterns of spermatogonial cell population kinetics indicate that there is some limited reserve of proliferative capacity, and the extent to which these changes may be due to decreasing the cell cycle time of a long-cycling type A/sub s/ stem-cell population in the type A cell compartment, or the bringing-in of a potentially proliferative type A/sub s/ population is now more clearly understood. These mechanisms are important in maintaining the steady-state of spermatogonial cell renewal under stress. The autoradiographic data indicate that under low level irradiation there are delays in the flow of the differentiated types A/sub 1-4/, intermediate, and type B spermatogonia in each proliferative subcompartment through the postsynthetic G_2 period into cell division, associated with a decrease in the duration of DNA synthesis, but with relatively normal cell cycle times. Under continuous exposure to low level irradiation, there is a differential radiosensitivity among the differentiated types A_1 to A_4, In and B cells affecting proliferation - depopulation is minimal but evident in type B and In cells, much less among types A/sub 1-4/ cells and preleptotene spermatocytes, and least in the type A/sub s/ stem-cell compartment.

45435 **Heavy particle comparative study. Pt. 2. Cell survival versus depth.** Raju, M.R.; Bain, E.; Carpenter, S.G.; Cox, R.A.; Robertson, J.B. (Los Alamos Scientific Lab., NM (USA)). *Br. J. Radiol.;* **51**: No. 609, 704-711(Sep 1978).

Cell-survival measurements with depth of penetration were made for a series of incident doses of proton, helium, carbon, neon, argon, negative pion, neutrons, and ^{60}Co photon beams. Cultured human cells (T_1) suspended in a gel-containing medium were used, and the measurements were found to be very useful in facilitating the design of ridge filters to produce isoeffects in the region of interest. Heavy charged particle beams (proton, helium, carbon, neon, and negative pion) were found to produce similar cell killing with depth of penetration. Because of saturation effects at higher LET, argon ions were less effective in killing aerated cells at depth, compared with other heavy charged-particle beams. Cell killing at depth in the region of interest, compared with that at the entrance, was not significantly different for single-field exposures when the Bragg peaks were broadened to cover a width of 10 cm. However, when two opposed fields with overlapping peaks were used, a large enhancement in killing was obtained in the peak region.

45436 Heavy particle comparative study. Pt. 3. OER and RBE. Raju, M.R.; Amols, H.I.; Bain, E.; Carpenter, S.G.; Cox, R.A.; Robertson, J.B. (Los Alamos Scientific Lab., NM (USA)). *Br. J. Radiol.;* **51**: No. 609, 712-719(Sep 1978).

The results of a comparative study of heavy particles of interest in radiotherapy are reported in four parts. In this Part III, cell-survival measurements under aerobic and hypoxic conditions were made for various heavy particle beams. For heavy charged-particle beams, the measurements were made at the beam entrance (plateau), peak centre (10 cm wide peaks), and distal peak (1 cm from dose fall-off). Chinese hamster cells (V79) were used. Metabolic depletion was used to obtain hypoxia. The results indicate that the differences in RBE between the entrance region and peak are not very large when the Bragg peaks are broadened to 10 cm. The RBE for argon ions remains the same at the entrance and peak centre, and the RBE at the distal side of the Bragg peak is significantly reduced compared to the peak centre and entrance region because of saturation effects at high LET. The OER for protons is not significantly different from that for X rays. The OER for helium ions, carbon ions, and negative pions is larger, for neon ions is similar, and for argon ions is smaller when compared with fast neutrons. The OER values for heavy ions are higher than expected and could be due to a large delta-ray penumbra association with the energy deposited by energetic heavy ions. The oxygen effect may depend upon energy deposition over distances of the order of nanometers.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

45437 (ORO—5601-T1) **Radiation and chemical effects on viral transformation and tumor antigen expression. Annual progress report, August 1, 1978—May 1, 1979.** Coggin, J.H. Jr. (University of South Alabama, Mobile (USA). Dept. of Microbiology/Immunology). 1979. Contract EE-77-S-05-5601. 23p. Dep. NTIS, PC A02/MF A01.

Studies aimed at the biological, biochemical, and immunologic characterization of fetal antigens (EA) in hamsters and mice and locating and determining the distribution of fetal antigens in tumor tissues and in developing fetuses have been underway for several months. Progress has been made in isolating embryonic or fetal antigens from fetuses and from tumor cells. We have developed and reported a reliable lymphocyte transformation assay (LTA) which meets our needs in routinely assaying cell free tumor associated antigen (TAA) preparations from fetal and tumor cells. The assay correlated with transplantation resistance assays and has appropriate specificity. We have also developed the staph-A protein binding assay utilizing anti-serum derived against embryonic antigens present on SV40 tumor cells. In other studies, we have reported increases and perturbations in thymocytes during viral and chemical oncogenesis in hamsters, have developed a simple technique for preserving functional lymphocytes sensitized against TAA by freezing for use in our model system work, have reported the cross-reactivity of tranplantation resistance antigen on a spectrum of chemically induced tumors previously believed to only contain individually specific TSTAs and have recently reported the cross-reactivity of papovavirus induced transplantation resistance antigen in sarcoma cells induced by different viruses. We have concluded our studies of glycosyltransferases in the membranes of developing fetuses and noted no differences in their levels with advancing days of gestation using whold embryo cell populations.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 45214, 45399, 45432, 45467, 45468

45438 (AD-A—059560) **Radiological hazards to air commerce.** Smith, W.S. Jr. (Federal Aviation Administration, Washington, DC (USA). Office of Environmental Quality). Feb 1978. 44p. NTIS PC A03/MF A01.

A survey of existing literature concerning radiological hazards to air commerce has been completed. A preliminary assessment of three major sources of potentially significant ionizing radiation has indicated that although some data are lacking, no actual danger to either passengers or crew has been documented. Cosmic radiation from galactic sources represents a relatively well understood and easily predictable phenomenon. Solar flare activity and nuclear testing episodes, however, are infrequent events which require an ongoing effort to maintain a current understanding of health and safety related issues.

45439 (LA-UR—79-231) **Comparison of two techniques for the determination of radiation quality.** Dicello, J.F.; Amols, H.I.; Zaider, M.; Tripard, G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 3p. (CONF-790812—2). Dep. NTIS, PC A02/MF A01.

From 5. international conference on medical physics; Jerusalem, Israel (19 Aug 1979).

A comparison is made between microdosimetric spectra measured with a spherical proportional counter, and a disk-shaped, solid-state detector at two positions in a large therapeutic pion beam. The determination of radiation quality from energy deposition spectra in proportional counters is a well-accepted technique. The use of solid-state detectors in microdosimetry, however, has been proposed only recently. It is shown here that the measured energy deposition spectra are strongly affected by the size and shape of the particular detector being used, and that significant differences exist between spectra obtained by the two techniques. Monte Carlo calculations done in conjunction with these measurements confirm these observations, and emphasize the fact that the effects of detector geometry need to be understood in order to interpret these microdosimetric spectra. Attempts to unfold the LET distributions with existing algorithms were unsuccessful because of the large numbers of particles stopping in the detector.

45440 (NTISUB/E—355) **Radiation carcinogenesis. Cancergram ck06.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 1979. aprox. 12 issuep. National Cancer Inst., Bethesda, MD.

The Cancergram deals with all aspects of radiation carcinogenesis. The term radiation here includes uv radiation and the entire electromagnetic spectrum, electron and other charged particle beams, neutrons, and alpha and beta radiation from radioactive substances. Abstracts included concern relationships between radiation and carcinogenesis in humans, experimental induction of tumors in animals by irradiation, studies on the mechanism of radiation carcinogenesis at the cellular level, studies of RBE, dose response or dose threshold in relation to radiation carcinogenesis, and methods and policies for control of radiation exposure in the general population. In general, this Cancergram excludes abstracts on radio-therapy, radiologic diagnosis, radiation pathology, and radiation biology, where these articles have no bearing on radiation carcinogenesis.

45441 (NTISUB/E—390) **Clinical treatment, of cancer: radiation therapy. Cancergram ct15.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 1979. aprox. 12 issuep. National Cancer Inst., Bethesda, MD.

The Cancergram covers all forms of radiotherapy being used in the treatment of cancer, including standard X-ray, cobalt 60 and radium irradiation as well as high linear energy transfer (LET), megavoltage, electron beam treatment and radioactive interstitial implants. Coverage of this topic includes adverse effects of radiotherapy, radiocurability, radiodosimetry, radiosensitization and studies with specialized instrumentation such as the betatron and linear accelerator. Radiobiology, animal experiments, tissue culture experiments, carcinogenesis and other preclinical studies will not be included except for those considered to have direct clinical relevance.

45442 (PB—284637) **Population exposure to VHF and UHF broadcast radiation in the United States.** Tell, R.A.; Mantiply, E.D. (Environmental Protection Agency, Las Vegas, NV (USA). Office of Radiation Programs). Jun 1978. 40p. NTIS PC A03/MF A01.

The U.S. Environmental Protection Agency has been collecting broadcast signal field intensity data for over two years to estimate population exposure to this form of nonionizing radiation. Measurement data have been obtained at 373 locations distributed throughout 12 large cities in the U.S. and collectively represent approximately 11,000 measurements of VHF and UHF signal field intensities. A computer algorithm has been developed which uses these data to estimate the broadcast exposure at some 39,000 census enumeration districts within the metropolitan boundaries of these 12 cities. A median exposure level (that level to which half of the population is exposed greater than) of 0.005 micro W/sq cm time

averaged power density has been determined for the population of the 12 cities studied, the cumulative population of which represents 18 percent of the total U.S. population. The data also suggest that approximately 1 percent of the population studied, or about 380,000, are potentially exposed to levels greater than 1 micro W/sq cm, the suggested safety guide for the population in the USSR.

45443 (PB—284639) **An analysis of radiofrequency and microwave absorption data with consideration of thermal safety standards. Final report.** Tell, R.A. (Environmental Protection Agency, Las Vegas, NV (USA). Office of Radiation Programs). Apr 1978. 56p. NTIS PC A04/MF A01.

An analysis of existing radiofrequency and microwave radiation absorption data has been performed to examine the frequency-dependent phenomenon of biological tissue heating. This analysis restricts itself to thermal considerations and examines the exposure field intensities associated with various levels of RF and MW induced thermal loading on both the body as a whole and specific, selectively absorbing tissues in adult humans and infants. An underlying absorption factor of 1W/kg is used for comparative purposes in the analysis. A method of specifying safety standard limits based on the electromagnetic field energy density rather than the plane wave, free-space equivalent power density is presented. The analysis reveals a particularly important resonance frequency range, 10 MHz < or = f < or = 1000 MHz, in which RF and MW absorption may lead to whole body thermal loads several times the whole body basal metabolic rate for exposures equal to the present safety standard in use in the United States. A discussion is developed for applications of this analysis to occupational environments and short duration exposure conditions.

45444 (PB—286690) **Bureau of Radiological Health Publications Index, August 1978. Report for 1953—1978.** (Bureau of Radiological Health, Rockville, MD (USA)). Aug 1978. 349p. NTIS PC A15/MF A01.

The Bureau of Radiological Health Publications Index to the publications of the Bureau of Radiological Health was prepared to aid in the retrieval and identification of publications originated or authored by Bureau staff or published by the Bureau. These publications include journal articles, government publications and technical reports, selected staff papers and Bureau news releases issued by HEW. For convenience, the document is divided into three sections, KWIC Index, Author Index, and Bibliography Index as described. A section on BRH Technical Reports Index by Subject is included. This portion of the Publications Index lists only those reports published by BRH since 1972.

45445 (PB—286750) **Administration of the Radiation Control for Health and Safety Act of 1968. Public Law 90-602. April 1, 1978 (1977 annual report). Report for 1 January—31 December 1977.** (Bureau of Radiological Health, Rockville, MD (USA)). 1 Apr 1978. 102p. NTIS PC A06/MF A01.

The Secretary of HEW is required by Subpart 3, Part F of Title III of the PHS Act; 42 USC 263 et seq. (P.L. 90-602) to submit an annual report to the President for transmittal to the Congress on or before April 1 on the administration of the Radiation Control for Health and Safety Act. The detailed information required to be included in the report is outlined in Section 360D of the PHS Act. The FDA, through its Bureau of Radiological Health has been delegated the authority for the day-to-day administration of the Act. This report covers the detailed operation of the Agency in carrying out that responsibility for calendar year 1977.

45446 **Correlation of total body potassium and leukemic cell mass in patients with chronic lymphocytic leukemia.** Chandra, P.; Sawitsky, A.; Chanana, A.D.; Chikkappa, G.; Cohn, S.H.; Rai, K.R.; Cronkity, E.P. (Brookhaven National Lab., Upton, NY). *Blood;* **53**: No. 4, 594-603(Apr 1979).

Total body leukemic mass in patients with chronic lymphocytic leukemia (CLL) was measured by quantitation of total body potassium (TBK) with a whole-body counter. In addition, the predicted normal total body potassium (Kp) for each patient was calculated from an empirically derived relationship involving height, weight age, and sex. Both the absolute TBK and the relative excess of total body potassium (TBK/Kp) were related to the stage of disease. Patients in the early stages of CLL were found to have lower TBK and TBK/Kp than patients in the late stages of disease. Both of these parameters increased with the successively advanced stages of the disease. The clinically monitored reduction of leukemic cell mass following therapy was accompanied by reductions in TBK and TBK/Kp. Data presented support the notion that TBK/Kp is a useful indicator of the total body leukemic mass. Futhermore, the results of these studies quantitatively validate the proposed clinical staging system for CLL. Quantitation of TBK by a whole-body counter is an accurate and noninvasive procedure and does not require administration of isotopes.

VERTEBRATES

REFER ALSO TO CITATION(S) 45434, 45440

45447 (CONF-790229—1) **Different effects of dose rate on radiation-induced mutation frequency in various germ-cell stages of the mouse, and their implications for the analysis of tumorigenesis.** Russell, W.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From 32. annual symposium on fundamental cancer research; Houston, TX, USA (27 Feb 1979).

The following factors affecting mutation induction by radiation in mice are discussed: dose rate, cell stage, and sex. It is suggested that for cancers of presumed mutational origin, the risk from chronic radiation exposure may be only one-third the risk from acute exposure. This is based only on responses of spermatogonia; other cell types behave quite differently. Specific and general applications are discussed. (HLW)

45448 (N—78-29730) **Influence of microwaves within the thermal intensity range in mice. Weight, rectal temperature, respiration, tread mill activity, reaction of senses, and learning.** Criborn, C.O. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Oct 1977. 47p. NTIS PC A03/MF A01.

Investigations show that mice exposed to microwave radiation of 2450 MHz, 100 mW/sq cm, for 3 to 6 min, change respiration activity and reaction of senses during exposure. Body temperature increases from 37 to 39 C during exposure. Reaction of senses is cut out after approx. 90 sec, followed by hyperventilation which can cause death in the animals if the exposure is not discontinued within 5 to 6 min. The first 3 days after exposure no negative influence on the tread mill activity or learning was observed. Long term studies of changes in tread mill activity and hemoglobin value showed that a diminution of these parameters occur approx. one week after radiation exposure, which is probably due to injuries of the blood-producing organs.

45449 (PB—286958) **CSU-FDA collaborative Radiological Health Laboratory annual report, 1977.** Benjamin, S.A. (Colorado State Univ., Fort Collins (USA). Collaborative Radiological Health Lab.). Aug 1978. Contracts FDA-72-302;FDA-223-76-6002. 128p. NTIS PC A07/MF A01.

The Collaborative Radiological Health Laboratory was established in 1962 by the Division of Biological Effects, BRH (then part of USPHS), and the Department of Radiology and Radiation Biology, Colorado State University, to assess possible long-term effects in the beagle from low-level whole-body gamma irradiation. The first section of this annual report summarizes the current status of the long-term effects of irradiation during development in the beagle. The second section addresses studies of radiation-induced and spontaneous disease in the beagle. Cardiovascular disease has also been noted to be a significant clinical disease problem in the aging beagle. The third section describes the CRHL data processing system as it existed and the current changes being made. Several aspects of the methods and procedures available for statistical analysis of data are discussed.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 45399, 45450, 45451

ANIMALS

45450 (PB—286691) **Advisory report on the health effects of radium 226 in drinking water.** (Illinois Univ., Chicago (USA). School of Public Health). Jun 1978. 82p. NTIS PC A05/MF A01.

Both human and animal studies have been done to examine the health effects of 226Ra. Although radium has several different isotopes, this document is primarily concerned with 226Ra. Only a few of the available animal studies on the effects of 226Ra are useful in the consideration of the effect of low doses of 226Ra. The limited usefulness of such studies is due to the small number of animals tested, and the single, high or unknown doses used. Those studies which have yielded useful results indicate 226Ra causes bone cancer at least at high doses. While the results of the study were not statistically significant, (equivocal), they did point to the possibility that those using such drinking water do have higher rates of bone cancer than others. The young (under eight years) seem to be particularly susceptible to the effects of 226Ra.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 45360, 45361, 45362

45451 (NUREG/CR—0789) **Internal dosimetry data and methods of ICRP. Part 1.** Ford, M.R.; Bernard, S.R.; Dillman, L.T.; Watson, S.B. (Oak Ridge National Lab., TN (USA)). 15 Sep 1978. Contract W-7405-ENG-26. 68p. (ORNL/NUREG/TM—315). Dep. NTIS, PC A04/MF A01.

The methodology being used to update the International Commission on Radiological Protection (ICRP) report of Committee 2, ICRP Publication 2 on Permissible Dose for Internal Radiation, is described. The system of differential equations, which is used to calculate the cumulated activity in the lungs, gastrointestinal tract, other body organs, and the transfer compartment of reference man, is presented. These equations describe the physical decay and metabolism of a radionuclide as governed by the lung and gastrointestinal tract models adopted by Committee 2 from models developed for the ICRP. The equations also take into account organ uptake and retention following intake into blood and the contribution of activity from radioactive daughter nuclides. Additionally, the scheme for estimating the dose from immersion in a radioactive cloud and the scheme for computing the nuclear decay data needed for all of the dose computations are presented. In computing the immersion dose, estimates for both the infinite and the finite cloud are considered.

ANIMALS

REFER ALSO TO CITATION(S) 45361, 45362

45452 Radiolabeled liposomes as metabolic and scanning traces in mice. II. In-111 oxine compared with Tc-99m DTPA, entrapped in multilamellar lipid vesicles. Espinola, L.G.; Beaucaire, J.; Gottschalk, A.; Caride, V.J. (Yale Univ., New Haven, CT). Contract EY-76-S-02-4078. *J. Nucl. Med.;* **20**: No. 5, 434-440(May 1979).

We describe the organ distribution of positively and negatively charged multilamellar lipid vesicles (MLV) labeled with Tc-99m DTPA or In-111 oxine in mice. The organ distribution of MLV (In-111 oxine) is fairly constant throughout 72 hr, indicating that the radiotracer remains associated with cellular structures at the site of MLV uptake. In animals injected with MLV (Tc-99m DTPA), on the other hand, there is continuous leakage of radioactivity from the involved organs. This can be explained by the release of radiotracer following MLV destruction in the organs. MLV (In-111 oxine) may be used to study MLV uptake by different organs, whereas MLV (Tc-99m DTPA) may be a good indicator of the destruction rate of lipid vesicles. Various conditions bearing on liposome kinetics merit further study in order to assess the potentialities of these vectors as diagnostic or therapeutic agents.

PLANTS

45453 (PNL—2850(Pt.2), pp 5.9-5.11) **Analog elements for transuranic chemistry.** Weimer, W.C.; Laul, J.C.; Kutt, J.C. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Naturally occurring elements which serve as analogs for some of the transuranic elements were demonstrated to be taken up by plants as a smooth function of elemental ionic radius. They remain unfractionated over geologic time periods. Pools of potentially available rare earth elements were defined by chemical extraction methods and were related to the pool of fallout transuranic elements in soils.

THERMAL EFFECTS

INVERTEBRATES

45454 (PB—288435) **The effects of temperature on the growth and survival of larval and juvenile crayfish (Pacifastacus leniusculus). Master thesis.** Cornacchia, J.W. (California Univ., Davis (USA). Dept. of Animal Science). Jun 1978. 74p. NTIS PC A04/MF A01.

The growth and survival of compartmentalized subyearling Pacifastacus leniusculus were studied in the laboratory at temperatures of 14.5 through 25.5C. Growth in weight was maximum at 22.0C. Cephalothorcic growth was .0642 mm/day (stages II-V) at the same temperature. The temperature predicted to produce optimum growth in length for stages II to V was calculated to be 20.0C. The effects of temperature on crayfish growth were primarily due to the acceleration of developmental rates as opposed to differences in incremental growth. Hiatt graphic analysis demonstrated that the coefficient of growth ranged from 1.16 to 1.33. Mortality was proportional to thermal shock during stage I. After stage I, crayfish reared at warmer temperatures had the best record of survival except at 17.0C. Morphometric analysis revealed that a linear relationship existed between diameter and weight of eggs. A new allometric model is presented that describes weight as a function of length of carapace in larval and juvenile stages.

VERTEBRATES

REFER ALSO TO CITATION(S) 45361, 45362

CHEMICALS METABOLISM AND TOXICITY

CELLS

REFER ALSO TO CITATION(S) 45433

45455 Selective growth of some rodent epithelial cells in a medium containing citrulline. Sun, N.C.; Sun, C.R.Y.; Tennant, R.W.; Hsie, A.W. (Oak Ridge National Lab., TN). *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 4, 1819-1823(Apr 1979).

We have defined a medium (called Sun's modified Waymouth medium) that selectively cultures some rodent epithelial cells that are capable of using citrulline in place of arginine. A growth-response study of the ability of 47 different mammalian cell cultures (of mouse, rat, Syrian hamster, Chinese hamster, guinea pig, rabbit, monkey, and human origin) to use arginine or its biosynthetic precursors, ornithine, citrulline, or argininosuccinate, showed that all epithelial cells and some fibroblasts are capable of growing in citrulline medium; however, primary embryo fibroblasts and 12 established fibroblast cell lines derived from Syrian hamsters failed to grow. The citrulline medium also allowed selective outgrowth of epithelial cells, without contaminating fibroblasts, from Syrian hamster tracheal explants. This absolute nutritional difference between Syrian hamster epithelial and fibroblast cells allows citrulline medium to be used for selective cultivation of epithelial cells, which should be valuable for study of growth, differentiation, and malignant transformation of mammalian epithelial cells.

PLANTS

REFER ALSO TO CITATION(S) 44726

45456 (BNL—50889) **Some potential effects of acid rain on forest ecosystems: implications of a computer simulation.** Botkin, D.B.; Aber, J.D. (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract EY-76-C-02-0016. 16p. Dep. NTIS, PC A02/MF A01.

Potential effects of acid precipitation on forest productivity and species composition were considered through the use of the JABOWA forest growth simulator. Physiological studies suggest that current levels of acid rain would result in a mortality of 5.5% or less of tree leaf tissue, depending on the species. Such reductions produce non-significant changes in the total productivity of the simulated forest. Significant changes in total productivity and relative species composition do occur at much higher levels of effects and are discussed. The simulations reported here consider only effects due to species interactions and direct impact on leaves; no changes and soil chemistry are assumed.

45457 (UCRL-Trans—11450) **Causes of and criteria for immission resistance in spruce, Picea abies (L.) Karst. IV. Recovery power of the needles, relationships between forms of resistance and summary of overall results.** Braun, G. Translated from *Eur. J. For. Pathol.;* **8**: 83-96(1978). 35p. Dep. NTIS, PC A03/MF A01.

Measurements of water potential in SO_2 treated Norway spruce showed that resistant clones recovered better than normal ones or at least showed less development of damage. Observation of needle discoloration gave only limited confirmation of this result. After fumigation, there was no relation of needle sulfur content and ability to recover. From a series of experiments on fumigation, it was concluded that reflexive and internal resistance were related. In a summary of the results of the series of four papers, the great importance of resistance to damaging materials is emphasized, and significant characteristics of resistant clones are indicated. There was also good evidence of a connection between pollution and drought resistance.

INVERTEBRATES

45458 (PNL—2850(Pt.2), pp 4.3-4.4) **Fate and effects of petroleum hydrocarbons in marine coastal ecosystems.** Vanderhorst, J.R. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

The objective of these studies is to evaluate effects from petroleum hydrocarbons at the population and community levels of biological organization. Identification of potential effects in laboratory studies and measurement of actual effects of field sites are the major subtasks.

45459 (PNL—2988) **Biocide by-products in aquatic environments. Quarterly progress report, January 1—March 31, 1979.** Anderson, D.R.; Bean, R.M.; Gibson, C.I.; Reed, P.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 55p. Dep. NTIS, PC A04/MF A01.

Results of organohalogen analysis of samples collected from marine and freshwater locations in the continental United States are presented. Analysis of ether extracts of these samples for the four major halogens, and for total organic halogen has shown that while halogenated component concentrations can vary widely from station to station, the bulk of the organic halogen is in the form of haloform. Chromatography of the extracts has shown the halogenated material to be less than 800 molecular weight. In the fresh water studies, chloroform was shown to be less toxic to largemouth bass (96 hr LC_{50} of 45-56 ppM), than rainbow trout (15-22 ppM), or bluegill (13 to 22 ppM). These levels are about three orders of magnitude higher than concentrations of haloform found in the chlorinated water sampling apparatus. Preliminary analysis of tissues from chloroform-exposed catfish indicate that this compound is concentrated in the fatty tissues and gut to levels of about an order of magnitude higher than the surrounding water. Analyses of tissues from the eastern oyster, quahaug clam, littleneck clam, menhaden, and shrimp exposed to bromoform over a 28-day period, have shown that bromoform uptake is rapid, with at least some bioconcentration observed in most cases. Depuration was also rapid, taking place within 48 hrs after termination of exposure. Specimens of littleneck clams which were exposed to seawater treated with up to 100 ppB chlorine have been studied with respect to growth and histology. It was found that this clam adapts poorly to being held in aquaria as evidenced by lack of growth for the first five months of the study and by the generally poor condition of their tissues during the initial phases. Clams exposed to less than 12 ppB chlorine were observed to recover. However, at higher concentrations, tissue damage was evident after six months and no growth was observed after eight months. (ERB)

VERTEBRATES

REFER ALSO TO CITATION(S) 45394, 45395, 45396, 45459

45460 (CONF-790334—3) **Dosimetry of coal and shale derived crude liquids as mouse skin carcinogens.** Holland, J.M.; Rahn, R.O.; Smith, L.H.; Clark, B.R.; Chang, S.S.; Stephens, T.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From Oil shale symposium; Denver, CO, USA (26 Mar 1979).

The following investigations were conducted: carcinogenic effects of coal liquids, shale oil, and crude petroleum on skin of mice; in vitro studies on skin PAH metabolism; and measurement of benzopyrene binding to target tissue DNA. The significance of the results for predicting carcinogenicity is discussed. (HLW)

45461 (LA—7736-MS) **Preliminary toxicological study of 5% palladium on alumina.** Drake, G.A.; Smith, D.M.; London, J.E.; Thomas, R.G. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

The acute oral LD_{50} values for 5% palladium on alumina in rats and mice were greater than 5 g/kg. According to classical guidelines, the material would be considered slightly toxic or practically nontoxic in both species. Skin application studies in the rabbit with 5% palladium on alumina demonstrated it to be mildly irritating. This material was a very mild and transitory irritant in rabbit eye-application studies. The sensitization study in the guinea pig did not show the material to be deleterious. The intratracheal instillation did cause pulmonary hemorrhages, inflammation, and congestion when given daily for 4 days but did not cause any deaths when given once a week for 10 weeks. Long-term studies in progress include single and multiple oral toxicity, multiple intratracheal instillations, and inhalation.

45462 (LA—7737-MS) **Preliminary toxicological study of dimerized phenyl propargyl ether (DPPE).** London, J.E.; Drake, G.A.; Smith, D.M.; Thomas, R.G. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

The acute oral LD_{50} values for dimerized phenyl propargyl ether (DPPE) in rats and mice were greater than 5 g/kg. According to classical guidelines, the material would be considered slightly toxic or practically nontoxic in both species. Skin-application studies in the rabbit with DPPE demonstrated it to be mildly irritating. This material was a very mild and transitory irritant in rabbit eye-application studies. The sensitization study in the guinea pig did not show the material to be deleterious. Intratracheal (IT) instillations resulted in mild focal areas of inflammation when given daily for 4 days; no fatalities occurred when DPPE was given once a week IT for 10 weeks. Long-term studies in progress include single and multiple oral toxicity, multiple intratracheal instillations, and inhalation.

45463 (LA—7738-MS) **Preliminary toxicological study of the hydrogen getter dimerized phenyl propargyl ether (DPPE)/5% palladium on alumina.** Drake, G.A.; London, J.E.; Thomas, R.G.; Smith, D.M. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

The acute oral LD_{50} values for dimerized phenyl propargyl ether/5% palladium on alumina (75%/25%) in rats and mice were greater than 5 g/kg. According to classical guidelines, the mixture would be considered slightly toxic or practically nontoxic in both species. Skin-application studies in the rabbit demonstrated it to be mildly irritating. This mixture was a very mild and transitory irritant in rabbit eye-application studies. A sensitization study in the guinea pig did not show the mixture to be deleterious. Intratracheal instillation daily for 4 days caused some deaths but, when done weekly for 10 wk, it caused no deaths during administration. Administration of each of the components by intratracheal instillation daily for 34 days resulted in pulmonary hemorrhages, inflammation, and congestion.

45464 (PNL—2850(Pt.2), pp 3.3-3.7) **Synfuels.** Bean, R.M.; Becker, C.D.; Poston, T.M.; Schneider, M.J.; States, J.B. Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 2. Ecological Sciences.

Static, short-term exposures of fish to various dilutions of Solvent Refined Coal (SRC) effluent were used in a preliminary evaluation of toxicity. In summary, short-term toxicity tests with SRC plant effluent indicate that treated process effluent passing through the biodigester, sand filter, and activated charcoal filter is relatively low in toxicity to aquatic life, and that untreated effluent originating within the plant contains chemical features highly toxic to aquatic life. Capillary gas chromatograms of aromatic hydrocarbons in treated and untreated SRC effluent indicated that untreated samples contained at least two orders of magnitude more material than did the treated effluent. Preliminary results are given on studies of sublethal phenol exposure on predator—prey relationships and gill adenosine triphosphate. (JGB)

MAN

45465 (CONF-790486—2) **Appropriate use of genetic toxicology in industry.** Epler, J.L.; Winton, W.; Hardigree, A.A.; Larimer, F.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From Biology division research conference on the scientific basis of toxicity assessment; Gatlinburg, TN, USA (15 Apr 1979).

The predictive value of short-term mutagenicity tests for potential genetic hazards and carcinogenic hazards in man remains in question. Microbial, insect, mammalian cell, and whole animal assays promote a variety of advantages and disadvantages depending on the test material. Metabolic activation of the compound(s) under test poses additional experimental questions. Extrapolation from one system to another in a comparative sense needs clarification. Further considerations of resolution, metabolism, synergism, and additivity arise when complex mixtures are evaluated in an industrial situation. The relationship of relative hazard in a short-term assay to relative hazard in man has to be approached with caution. A series of representative genetic toxicological procedures is described and precautions inherent to their use and interpretation are presented.

45466 (COO—2874-42) **SIMS three year study on statistics and environmental factors in health. Final (preliminary) summary report.** (SIAM Inst. for Mathematics and Society, Philadelphia, PA (USA)). Nov 1978. Contract EY-76-S-02-2874. 53p. Dep. NTIS, PC A04/MF A01.

The three main parts of the report were prepared by SIMS, Columbia University, and Stanford University. The reports by Columbia and Stanford concern the research and educational features of the study; the report from SIMS presents some of its principal activities in connection with project coordinating and financial support functions.

45467 (NTIS/PS—78/1302) **Environmental carcinogens. Volume 2. November, 1976—December, 1978 (a bibliography with abstracts). Report for Nov 1976—Dec 1978.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Dec 1978. 211p. NTIS PC N01/MF N01.

The bibliography cites research reports on the identification, sources, and health effects of environmental carcinogens. Included

are studies on pesticides, fire extinguishing agents, environmental pollutants, food additives, radiation, and other known or suspected carcinogenic substances. (This updated bibliography contains 204 abstracts, 90 of which are new entries to the previous edition.)

45468 (NTISUB/E—296) **Carcinogenesis studies not covered by other subscriptions.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 1979. aprox. 10 issuep. National Cancer Inst., Bethesda, MD.

The subscription of current cancer research projects is a service of the International Cancer Research Data Bank (ICRDB) Program of the National Cancer Institute. It is comprised of listings describing ongoing projects in one selected cancer research area. The descriptions are provided by cancer scientists in about 50 different countries. The purpose of these listings is to facilitate and promote cooperation and exchange of information between cancer scientists by keeping them aware of ongoing projects related to their research in other laboratories throughout the world. This particular subscription offers a complete set of current cancer research listings in the area of carcinogenesis studies not covered by other subscriptions. The individual reports a subscriber will receive throughout the year cover the following topics: Occupational carcinogenesis and related studies; carcinogenic substances in food and drugs and related epidemiology; organic chemicals in occupational and experimental carcinogenesis (excluding most polycyclic and nitroso compounds); radiation carcinogenesis; role of hormones in carcinogenesis and related studies of hormone receptors; nitroso compounds; polycyclic aromatic hydrocarbons; modification of carcinogenesis in model systems; effects of chemical carcinogens on nucleic acids, proteins, and chromosomes; environmental and occupational factors in human cancer, and related studies on major inorganic carcinogens; and selected factors associated with increased risk/incidence of human cancer.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

45469 (AD-A—059870) **Biological effects of nonionizing electromagnetic radiation. Volume III. Number I. A digest of current literature. Quarterly report, June—September 1978.** Kleinstein, B.H.; Saboe, E.P. (Franklin Research Center, Philadelphia, PA (USA). Science Information Services Organization). Sep 1978. Contract TP-7AC024. 54p. NTIS PC A04/MF A01.

This quarterly digest presents current awareness information on the biological effects of nonionizing electromagnetic radiation (microwave and radio frequency) in the range of 0 Hz to 100 GHz. The effects of magnetic and electric fields (static and alternating) are also covered. Each issue contains abstracts of English and foreign current literature, summaries of ongoing research investigations, news items, and a directory of meetings and conferences. (Author)

45470 (PB—286931) **Impacts of transmission lines on birds in flight. Proceedings of a workshop held at Oak Ridge Associated Universities, Oak Ridge, Tennessee on 31 January—2 February 1978.** Avery, M.L. (National Plant Power Team, Ann Arbor, MI (USA)). Sep 1978. 160p. NTIS PC A08/MF A01.

The proceedings of this 3-day workshop address the impacts to birds of the proliferation of power lines, cooling towers, tall stacks, radio and TV towers, and tall buildings. The eight invited papers included in the proceedings examine the extent of the problem, review available knowledge, discuss specific examples, and identify research needs on the impacts of electric power transmission lines on local and migratory movements of birds. Reports from working groups on behavior, habitat, migration, management options, and research priorities, and an extensive bibliography are included.

HEALTH AND SAFETY

45471 (LA—7877-MS) **Accident/incident investigation techniques.** Bacastow, J.L. (Los Alamos Scientific Lab., NM (USA)). Oct 1978. Contract W-7405-ENG-36. 29p. Dep. NTIS, PC A03/MF A01.

This report (extracted and condensed from ERDA-76-20 Accident/Incident Investigation Manual) is designed to assist persons not formally trained in accident/incident investigation techniques who have been assigned in the capacity of chairperson or member of an investigation board. It discusses the establishment and functions of an investigative board, and the writing of an accident report.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 44384

45472 (LA—7455-MS) **Sorption—desorption studies on argillite. I. Initial studies of strontium, technetium, cesium, barium, cerium, and europium.** Erdal, B.R.; Aguilar, R.D.; Bayhurst, B.P.; Oliver, P.Q.; Wolfsberg, K. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 76p. Dep. NTIS, PC A05/MF A01.

Distribution ratios were determined for sorption—desorption of radioactive tracers between Eleana argillite available from the Nevada Test Site and a water prepared to be representative of the natural groundwater composition. The measurements were preformed at 22°C and 70°C under atmospheric oxygen conditions. The order of increasing distribution coefficient by element at both temperatures is Tc(VII), Sr, Cs, Ba, Eu, and Ce. The effects of surface area and mineralogy were also investigated. 34 figures, 26 tables.

45473 (PNL—2894) **Hanford wells.** McGhan, V.L.; Damschen, D.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 203p. Dep. NTIS, PC A10/MF A01.

The Hanford Site contains over 2200 wells constructed from pre-Hanford Works days to the present. More than 200 older wells were mostly hand-dug farm wells, many of which are no longer usable or even visible. The newer wells are cased wells which were either churn-drilled, drive-barrel-drilled or rotary-drilled. This report provides a complete documentation of wells in and adjacent to the Hanford Site. It supersedes all previous compilations of Hanford wells, the most recent being June 1977 (BNWL—2296). Not included in this report or the master record are those destroyed farm wells which were never surveyed into the Hanford coordinate system nor used for water-table measurements or water sample collection. References 1, 2, and 3 contain the available data on these wells. While considerable effort has been made to obtain the most accurate and complete tabulation possible of the Hanford Site wells, inevitable some omissions and errors may exist, paticularly for old farm wells. Periodic additions and corrections to this document will be issued to be made a part of this report.

GEOPHYSICS

REFER ALSO TO CITATION(S) 45356

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 45505

45474 (NUREG/CR—0689) **Methods for prediction of strong earthquake ground motion.** (University of Southern California, Los Angeles (USA). Dept. of Civil Engineering). Feb 1979. 532p. NTIS, PC A24/MF A01.

This report summarizes the work on characteriztion of strong earthquake ground motion for use in seismic risk studies, development in modern standards and regulatory guides, re-evaluation of the existing sites and for the development of site specific criteria for earthquake-resistant design. This work was carried out from 1 October 1977 to 30 September 1978. This is an on-going effort in which certain topics are continued through more than one fiscal year. Consequently, this report summarizes only the current accomplishments. Detailed theoretical analyses, data handling methods, computer programs, and other pertinent background are presented. 207 references, 159 figures, 33 tables.

45475 (UCRL—52458) **Methods to develop site specific spectra and a review of the important parameters that influence the spectra.** Bernreuter, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 45p. Dep. NTIS, PC A03/MF A01.

Problems with using risk analysis methodologies to estimate the seismic hazard at a site are discussed in the context of the U.S. Nuclear Regulatory Commission's Systematic Evaluation Program (SEP). Various methodologies that may reasonably define seismic hazard are outlined. The major assumptions that can lead to significant variations in the predicted hazard are identified. Guidance is provided to appropriate choices of parameters, and possible corrections that can extend the meager earthquake data base for sites located in the eastern United States are presented. A method that incorporates various interpretations of the same data is recommended.

45476 Wave attenuation in partially saturated rocks. Mavko, G.M.; Nu, A. (Stanford Univ., CA). *Geophysics;* **44**: No. 2, 161-178(Feb 1979).

A model is presented to describe the attenuation of seismic waves in rocks with partially liquid-saturated flat cracks or pores. The presence of at least a small fraction of a free gaseous phase permits the fluid to flow freely when the pore is compressed under wave excitation. The resulting attenuation is much higher than with complete saturation as treated by Biot. In general, the attenuation increases with increasing liquid concentration, but is much more sensitive to the aspect ratios of the pores and the liquid droplets occupying the pores, with flatter pores resulting in higher attenuation. Details of pore shape other than aspect ratio appear to have little effect on the general behavior, provided the crack width is slowly varying over the length of the liquid drop. 9 figures, 2 tables.

GEOPHYSICAL SURVEY METHODS

45477 (UCRL—81901) **Cross-borehole geophysical probing for site characterization.** Lytle, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Mar 1979. Contract W-7405-ENG-48. 11p. (CONF-790617—1). Dep. NTIS, PC A02/MF A01.

From 1979 rapid excavation and tunneling conference; Atlanta, GA, USA (18 Jun 1979).

Ground structure is commonly estimated from core samples taken from boreholes. However, knowledge of the structure exterior to the borehole can only be extrapolated from core data. By using seismic and electromagnetic cross-borehole geophysical probing, remote probing can be used to sense the region exterior to boreholes. A new procedure, called geotomography, utilizes large amounts of data and provides a detailed picture of the subsurface. Several examples of geotomography applied to imaging ground structure are presented. It is concluded that cross borehole probing can be successfully used for determining the structure existing between boreholes. A clear visual presentation can be given to a nonspecialist which provides him with a readily interpretable picture of the structure. This data processing can be performed in minimal time at the site. 8 figures. (RWR)

45478 Vector EM system and its field applications. Hohmann, G.W. (Univ. of Utah, Salt Lake City); Vanvoorhis, G.D.; Nelson, P.H. *Geophysics;* **43**: No. 7, 1418-1440(Dec 1978).

Kennecott Exploration Services built and applied widely a unique vector electromagnetic (VEM) system that measures magnetic field amplitude and phase at four frequencies: 26, 77, 232, and 695 Hz. Stable crystal oscillators enable phase measurement without a wire link for any transmitter—receiver configuration. A square wave is transmitted into a loop, and the signal is read at two frequencies: the fundamental and the third harmonic. The amplitude readout is logarithmic with switched 10-dB gain increments. Amplitude resolution is 0.1 dB, and phase resolution is 0.5 degree. The VEM system was applied successfully in a wide variety of exploration terranes and in several field geometries. For reconnaissance work, a large rectangular source loop similar to the Turam geometry is used, but with only one receiver coil. Amplitude and phase data can be reduced to field strength ratio and phase difference, as in Turam, or to in-phase and quadrature components. In-phase and quadrature are better for deep targets, because the standard Turam reduction discriminates against deep conductors. For investigations of narrow zones or for defining a conductor, a fixed vertical loop source is used; in that case, the receiver measures the amplitude and phase of the vertical field, rather than the conventional tilt angle. Borehole EM surveys (surface transmitter—downhole receiver and downhole transmitter—surface receiver) are useful both for determining whether an anomaly has been tested by drilling, and for mapping conductors. 32 figures.

45479 Maximum induced voltage between coaxial coils. Caffey, T.W.H. (Sandia Lab, Albuquerque, NM). *IEEE Trans. Geosci. Electron.;* **GE-16**: No. 4, 314-315(Oct 1978).

The use of two coaxial coils, whose winding planes are horizontal, for signaling between a surface coil and a coil within the earth is well known. Simple formulas are given for the maximum induced voltage and the frequency at which the maximum occurs. The formulas apply to many combinations of soil conductivity and dielectric constant and are accurate to within ten percent.

45480 Electromagnetic depth sounding experiment. Biewinga, D.T. (Delft Univ., Netherlands). *Geophys. Prospect.;* **25**: No. 1, 13-28(Mar 1977).

An electromagnetic frequency sounding experiment with a rigid horizontal transmitter coil carrying a stabilized oscillating current was carried out in South Tunisia. The field data were interpreted in terms of the mutual impedance ratio in the horizontal coils system. Where the measurements were sufficiently accurate they generally could be interpreted to a high degree of fit. It is concluded that a vehicle-mounted electromagnetic frequency sounding system is suitable for a fast survey.

45481 Electromagnetic coupling. Wynn, J.C. (Geological Survey, Denver, CO); Zonge, K.L. *Geophys. Prospect.;* **25**: No. 1, 29-51(Mar 1977).

Electromagnetic coupling in grounded electrical prospecting systems has been studied for over four decades. Recently, advanced digital electronic systems have been developed which permit both magnitude and phase measurements over four frequency decades (10^{-2}-10^{2} Hz). This development has stimulated theoretical studies demonstrating the behavior of EM coupling for the more commonly-used electrical prospecting arrays over a wide frequency range. A comparison is made between field and theoretical results which demonstrates the validity of the fundamental assumptions involved. Additionally electromagnetic coupling is used successfully as a deep-sounding technique in a highly-conductive sedimentary basin environment.

45482 Example of the application of the rules of composition in resistivity interpretation. Mohammed, S.A.G.; Habberjam, G.M. (Univ. of Leeds, England). *Geophys. Prospect.;* **25**: No. 1, 52-60(Mar 1977).

The application of approximate rules, whereby apparent resistivity space sections for two dimensional structures can be composited from spaces derived for elementary features is extended to a complex example drawn from a field survey over a fluorite mineral vein. A quantitative solution for the observed resistivity space is presented and the computational sequence involved in matching the observed space is given in detail. The interpreted results are examined in relation to the known geology, supplemented by the results of excavation, and to model tests conducted using a tank analogue. The example also illustrates how successive compositions can be employed in estimating the form of resistivity space in a relatively complex situation.

45483 Estimation of depth to conductors by the use of electromagnetic transients. Lee, T. (I.A. Richardson and Assoc. Pty. Ltd., Chatswood, N.S.W., Australia). *Geophys. Prospect.;* **25**: No. 1, 61-75(Mar 1977).

The transient response of a layered structure to plane wave excitation can be considered to be composed of a series of waves and a ground wave. For the case of a half-space of conductivity σ and permeability μ the maximum in the electric field is found at a depth z and time t when $t = z^2\sigma\mu/2$. This formula can be used to estimate the depth to a buried horizontal conductor with an accuracy that depends upon the resistive contrast at the conductor's surface. The above ray type of solution can be converted to a solution composed of a number of modes by the use of a Poisson transform and the transformed solutions yield decay constants that are consistent with the previously reported results. In the case of a finite source, the maximum in the electric field is strongly directed. The direction depends upon the geometry of the source and the air-earth interface. Although the maximum varies with direction it can be shown that in some directions similar laws to that above are valid. The depth to a conductor can be estimated from the early part of the transients when the ground wave is removed. The removal of the ground wave from the transient is facilitated by the use of an apparent conductivity formula. Although these results were obtained under restrictive conditions they do provide some insight into the electrical transients that are encountered by studying more complex models.

45484 Influence of altitude and displacement currents on plane-wave EM fields. Sinha, A.K. (Geological Survey of Canada, Ottawa). *Geophysics;* **42**: No. 1, 77-91(Feb 1977).

From 45. annual internal SEG meeting; Denver, CO, USA (15 Oct 1975).

Airborne electromagnetic mapping by wavetilt measurement is especially suitable for highly resistive strata like the permafrost terrains of northern Canada. A theoretical study was made on the influence of the altitude of the aircraft and displacement currents on the measured wave tilt values over a range of frequency from VLF (very low frequency) to BCB (broadcast band). A computer modeling study indicated that the effects of displacement currents cannot be ignored over resistive ground if the frequency is greater than 100 kHz. The altitude effect is significant beyond 20 m for medium frequencies and resistive ground. The phase of the wavetilt is almost always more sensitive to these factors than the amplitude. When the top layer is thicker than three skin depths in that layer, the effects of lower layers on the wavetilt is negligible. It is also apparent that before attempting to interpret wavetilt data over a layered medium, one should carefully determine the nature of the source field. The results are readily applied to the Barringer E-phase System, an airborne EM technique which measures the quadrature part of the wavetilt at three frequencies from VLF to BCB range. If the effects of altitude and displacement currents are ignored, the calculated apparent resistivities from E-phase data will be much less than the true resistivities, even for moderately resistive ground. A graphical technique is presented for correctly estimating the resistivity values from two-frequency E-phase measurements when the electrical constants are not frequency dependent.

45485 Electromagnetic sounding with susceptibility among the model parameters. Thomas, L. (Univ. of Melbourne, Parkville, Australia). *Geophysics;* **42**: No. 1, 92-96(Feb 1977).

The response of electromagnetic sounding systems is insensitive to the ordinary variations in magnetic susceptibility. However, in layered earth models susceptibilities of more than 0.005 may affect the system response appreciably, and susceptibility values of this magnitude might be determined by model fitting to parametric sounding observations. Electromagnetic soundings might, therefore, be used to reveal the existence of remanent magnetization in some cases. These conclusions are drawn from numerical studies with theoretical models.

45486 Telluric anomalies caused by shallow structures: ellipsoidal approximations. Lee, T.C. (Univ. of California, Riverside). *Geophysics;* **42**: No. 1, 97-102(Feb 1977).

An analytical solution for the electric field near an ellipsoid immersed in a semiinfinite medium is obtained to estimate the effect of shallow structures on telluric measurements. The determinant J of the Jacobean, which transforms telluric field from base to roving stations, may change across the boundary of different media by a factor equal to their resistivity ratio. At distances beyond one length of the intermediate axis from the edge f the ellipsoid, both the J-anomaly and the polarization of the normalized telluric field become negligible.

45487 Enhancement of signal-to-noise ratio in magnetotelluric data. Kao, D.W. (Univ. of Ife, Ile-Ifa, Nigeria); Rankin, D. *Geophysics;* **42**: No. 1, 103-110(Feb 1977).

A new technique was developed that can be employed for the enhancement of the signal-to-noise ratio of magnetotelluric data and/or for the establishment of a confidence limit as a criterion for final data selection. This technique functions in a consecutively cyclic process which can finally remove the noise from the autopower estimates of MT data if the crosspower estimates are noise free and, consequently, the predicted coherencies can be improved. When noise exists in both autopower and crosspower estimates, the cyclic operation can establish a confidence limit which reveals a direct measure of incoherent noise content and thus is a more reliable criterion than the predicted conherency itself for data selection. The technique is tested using actual MT data and the result shows the adequacy of the technique. It selects useful data from those originally having moderate or low predicted coherencies; thus it appears to be important when the predicted coherency of the majority of the collected data is not high.

45488 Model for estimating electric macroanisotropy coefficient of aquifers with horizontal and vertical fractures. Campbell, D.L. (Geological Survey, Denver, CO). *Geophysics;* **42**: No. 1, 114-119(Feb 1977).

Electrically resistant beds often contain water-bearing fractures having a much lower resistivity than the beds themselves. A model is presented for estimating the macroanisotropy coefficient of such fractured beds.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

45489 (FE—5200-T1) **Quarterly technical progress report No. 10, January 1—March 31, 1979.** Struble, R.A. (Ohio Dept. of Natural Resources, Columbus (USA). Div. of Geological Survey). Apr 1979. Contract EY-76-S-05-5200. 8p. Dep. NTIS, PC A02/MF A01.

Study of Devonian shales continued. Several cores and drill cuttings were washed and analyzed. The work may be categorized as follows: resource inventory (stratigraphy and structure); shale characterization (mineralogy and petrology, geochemistry, gas detection, well locations, data collection). (RWR)

45490 (ORNL/TM—6809) **Thermal conductivity of rock salt from Louisiana salt domes.** Morgan, M.T. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

The thermal conductivities of dome salt samples from the Avery Island and Jefferson Island Mines in southern Louisiana were determined as part of an evaluation of these formations for use as possible waste repositories. The thermal conductivities ranged from 4 W/m K at 70°C to 2 W/m K at 300°C. The average thermal conductivity of the dome salt at 100°C was ~ 25% less than that of a single-crystal salt at 100°C. The thermal conductivity was found to be related to the density and fragility of the salt. The thermal conductivies were measured using a comparative technique in which the sample was sandwiched between standard references of Pyroceram 9606. The precision of the method is within +- 10% and th overall error is within +- 20%. Considerable attention was given to specimen preparation. Finished surfaces were parallel within 0.005 in. and flat to within 0.0005 in. Chromel-Alumel thermocouples were installed in grooves on interface surfaces to measure temperatures.

45491 (Y/OWI/SUB—77/22303/5) **Case history rock mechanics examination of the Jefferson Island Salt Mine: II. Laboratory evaluation of strength and creep deformation characteristics of dome salt under confining pressure.** Hansen, F.D. (RE/SPEC, Inc., Rapid City, SD (USA)). 10 Jun 1977. Contract W-7405-ENG-26. 116p. Dep. NTIS, PC A06/MF A01.

This report presents the results of a laboratory effort to determine the quasi-static triaxial compressive strength and triaxial creep properties of dome salt from the Diamond Crystal Salt Mine, Jefferson Island, LA. The samples tested were nominally two inches in diameter and four inches in length. Stress-strain relationships for quasi-static compression are presented and mechanical properties are calculated. Time-strain and power law creep relationships are also presented. The creep data are further analyzed to evaluate parameters for a new formulation of a creep law based on internal thermodynamic variables. Mechanical properties, strength data and empirical relationships of strain as a function of time and stress are reduced for application to finite element codes. 21 figures, 6 tables.

45492 (Y/OWI/SUB—77/22303/7) **Case history rock mechanics examination of the Jefferson Island Salt Mine: III. Evaluation of laboratory specimen dimensions on the uniaxial strength and deformational characteristics of dome salt.** Stickney, R.G. (RE/SPEC, Inc., Rapid City, SD (USA)). 27 Sep 1977. Contract W-7405-ENG-26. 149p. Dep. NTIS, PC A07/MF A01.

This report presents the results of a laboratory effort to determine the unconfined strength and elastic properties of dome salt from the Diamond Crystal Mine, Jefferson Island, LA. The effects of sample size and geometry on the compressive properties of this salt were investigated, and relationships for compressive strength and deformational modulus as a function of specimen diameter and length to diameter ratio were developed. The results of a finite-element analysis of the stress state in a specimen loaded between steel platens are also presented. 20 figures, 4 tables.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 44385

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 45438, 45506

STARS

REFER ALSO TO CITATION(S) 45614, 45621

45493 (LA-UR—79-920) **Nonlinear calculations for bump Cepheids.** Hodson, S.W.; Cox, A.N. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790364—2). Dep. NTIS, PC A02/MF A01.

From Nonradial and nonlinear stellar pulsation workshop; Tucson, AZ, USA (12 Mar 1979).

Hydrodynamic calculations to find strictly periodic solutions for the fundamental mode pulsations of 7 M/sub sun/ models were made using the von Sengbusch—Stellingwerf relaxation method. The models have a helium enrichment in the surface convection zones to Y = 0.78, which from the linear theory period ratio π_2/π_0 and the Simon and Schmidt resonance hypothesis, should give the observed Hertzsprung progression of light and velocity curve bump phase with period. These surface helium enhanced models show the proper nonlinear bump phase behavior without resort to any mass loss before or during the blue loop phases of yellow giant evolution. At 6000 K and the evolution theory luminosity of 4744 L/sub sun/ for 7 M/sub sun/, that is, at a fundamental mode period of 8.5 day, the velocity curve bump is well after the maximum expansion velocity. At 5400 K and at the same luminosity (period of 12.5 days), there is a bump on the velocity curve well before maximum expansion velocity time. The latter case seems to exhibit the Christy echos but not the former. The echo interpretation may not be appropriate for these masses which are larger than the anomalous masses used by Christy, Stobie, and Adams. Resonance of the fundamental and second overtone modes should not necessarily show echos of surface disturbances from the center. The conclusion is that helium enrich-

ment in the surface convection zones can adequately explain observations of bump Cepheids at evolution theory masses. 12 references.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

45494 (N—78-29539) **Joint observations of 4U1223-62 by the SAS-3 satellite and Columbia University proportional counter experiment on NASA rocket 26.054 UH. Final report, 1 Aug. 1977 - 31 Jul. 1978.** Novick, R.; Wolff, R.S. (Columbia Univ., New York (USA). Columbia Astrophysics Lab.). Aug 1978. 10p. NTIS PC A02/MF A01.

The pulsating X-ray binary 4U1223-62 and Vela X-1 were observed by Aerobee rocket-borne proportional counters. Valid X-ray events were telemetered and analyzed for possible flaring, quasi-periodic and periodic pulsations, and for other nonstatistical behavior in the source. Both fast Fourier transform and autocorrelation programs were used. For several hours four days before and after the rocket flight, the SAS-3 satellite scanned the galactic plane in order to identify X-ray sources in the vicinity of 4U1223-62 and their intensities, and to provide positional accuracy of 0.25 for sources with intensity greater than 10% of the target. Observations of the source near the main peak of its pulsating period as defined by SAS-3 are discussed. There is no evidence of a spectral feature although twice as many photons were received as than from Vela X-1.

45495 (N—78-30035) **Energy spectrum of medium energy gamma-rays from the galactic center region.** Palmeira, R.A.R.; Ramanujarao, K.; Dutra, S.L.G.; Bertsch, D.L.; Kniffen, D.A. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1978. 23p. NTIS PC A02/MF A01.

A balloon-borne magnetic core digitized spark chamber with two assemblies of spark chambers above and below the scintillation counters was used to measure the medium-energy gamma ray flux from the galactic center region. Gamma ray calculations are based on the multiple scattering of the pair electrons in 15 aluminum plates interleaved in the spark chamber modules. Counting rates determined during ascent and at ceiling indicate the presence of diffuse component in this energy range. Preliminary results give an integral flux between 15 and 70 MeV compared to the differential points in other results.

45496 (N—78-30037) **The annihilation of galactic positrons.** Bussard, R.; Rematy, R. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 24p. NTIS PC A02/MF A01.

The probabilities of various channels of galactic positron annihilation were evaluated and the spectrum of the resulting radiation was calculated. The narrow width (FWHM less than 3.2 keV) of the 0.511 MeV line observed from the galactic center implies that a large fraction of positrons should annihilate in a medium of temperature less than 100,000 K and ionization fraction greater than 0.05. HII regions at the galactic center could be possible sites of annihilation.

45497 (N—78-34013) **X ray spectra of X Per.** Becker, R.H.; Boldt, E.A.; Holt, S.S.; Pravdo, S.H.; Robinson-saba, J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1978. 17p. NTIS PC A02/MF A01.

The cosmic X-ray spectroscopy experiment on OSO-8 observed X Per for twenty days during two observations in Feb. 1976 and Feb. 1977. The spectrum of X Per varies in phase with its 13.9 min period, hardening significantly at X-ray minimum. Unlike other X-ray binary pulsar spectra, X Per's spectra do not exhibit iron line emission or strong absorption features. The data show no evidence for a 22 hour periodicity in the X-ray intensity of X Per. These results indicate that the X-ray emission from X Per may be originating from a neutron star in a low density region far from the optically identified Be star.

45498 (N—78-34015) **Particle acceleration in pulsar magnetospheres.** Baker, K.B. (Stanford Univ., CA (USA). Inst. for Plasma Research). Oct 1978. Contract NGR-05-020-668. 77p. NTIS PC A05/MF A01.

The structure of pulsar magnetospheres and the acceleration mechanism for charged particles in the magnetosphere was studied, using a pulsar model which required large acceleration of the particles near the surface of the star. A theorem was developed which showed that particle acceleration cannot be expected when the angle between the magnetic field lines and the rotation axis is constant (e.g. radial field lines). If this angle is not constant, however, acceleration must occur. The more realistic model of an axisymmetric neutron star with a strong dipole magnetic field aligned with the rotation axis was investigated. In this case, acceleration occurred at large distances from the surface of the star. The magnitude of the current can be determined using the model presented. In the case of nonaxisymmetric systems, the acceleration is expected to occur nearer to the surface of the star.

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 45438, 45504, 45506

45499 (N—78-34023) **Proposed rocket experiments to measure the profile and intensity of the solar He1584A resonance line. Semi-annual status report, 1 July 1977—31 December 1977.** Judge, D.L. (University of Southern California, Los Angeles (USA)). 23 Feb 1978. 80p. NTIS PC A05/MF A01.

The intensity and profile of the helium resonance line at 584A from the entire disc of the sun was investigated using a rocket-borne helium-filled spectrometer and a curve of growth technique. The line profile was found to be accurately represented by a Gaussian profile with full width at half maximum of 122 +- 10m A while the integrated intensity was measured to be (2.6 +- 1.3) x 10^9/photons sec cm^2 at solar levels of F sub 10.7/ = 90.8 x 10^{-22}/sq m^2 H/sub z/ and R/sub z/ = 27. The measured linewidth is in good agreement with previous spectrographic measurement but the integrated intensity is larger than most previous photoelectric measurements. However, the derived line center flux of (2.0 +- 1.0) x 10^{10}/photons sec cm^2 A is in good agreement with values inferred from airglow measurements.

45500 (N—78-34024) **Updating of ADAPT predictions of sunspot activity. Final report, November 1977 - June 1978.** Hunter, H.C. (ADAPT Service Corp., Reading, MA (USA)). Jul 1978. Contract NAS8-32851. 108p. NTIS PC A06/MF A01.

An eigenvector analysis procedure was used to analyze and develop algorithms for predicting sunspot numbers. The predictors in these algorithms consist of sunspot numbers from the preceding two solar cycles and magnetic index data from the preceding cycle. Predictions are presented for cycles 21 and 22. The sunspot activity for cycle 21 is predicted to remain below 100 until early 1980, when it will rapidly reach a peak of approximately 120. The two-sigma accuracy on these estimates is approximately 20 sunspot numbers in the region of the peak and 10 sunspot numbers early and late in the cycle. Algorithms were also developed for predicting the period of future sunspot cycles using the same predictor vector.

45501 **Study of radio-wave fluctuations and turbulence of the near-solar plasma in experiments with radio transmission in the Venus-10 apparatus.** Kolosov, M.A.; Yakovlev, O.I.; Rogal'skii, V.I.; Efimov, A.I.; Razmanov, V.M.; Shtrykov, V.K. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 7, 440-442(Jul 1978).

Spectral broadening of 928-MHz radiation was observed for propagation through the near-solar plasma. Amplitude fluctuations as a function of angular distance between the sun's center and the Venus-10 apparatus were studied in detail. (AIP)

GALAXIES

REFER ALSO TO CITATION(S) 45496

PLANETARY PHENOMENA

45502 (N—78-30023) **Interplanetary magnetic holes: theory.** Burlaga, L.F.; Lemaire, J.F. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 24p. NTIS PC A02/MF A01.

Magnetic holes in the interplanetary medium are explained as stationary, non-propagating, equilibrium structures in which there are field-aligned enhancements of the plasma density and/or temperature. Magnetic anti-holes are considered to be associated with depressions in the plasma pressure. In this model, the observed changes in the magnetic field intensity and direction are due to diamagnetic currents that are carried by ions which drift in a sheath as the result of gradients in the magnetic field and in the plasma pressure within the sheath. The thickness of the sheaths considered is approximately a few ion Larmor radii. An electric field is normal to the magnetic field in the sheath. Solutions of Vlasov's equation and Maxwell's equations are presented which account for several types of magnetic holes, including null-sheets, that were observed.

45503 (N—78-30026) **Organic molecules in the atmosphere of Jupiter. Final report.** Ponnamperuma, C.A. (Maryland Univ., College Park (USA)). 1978. Contract NAS5-20834. 2p. NTIS PC A02/MF A01.

Organic synthesis in the primitive solar system was simulated by Fischer Tropsch type experiments. Particular attention was given to the formation of lower molecular weight hydrocarbons. In a gas flow experiment, a gas mixture of H_2 and CO was introduced into a heated reaction tube at a constant flow rate and passed through a

catalyst (powdered Canyon Diablo). The products that emerged were directly analyzed by gas chromatography. The results of 21 runs under various gas mixing rations, reaction temperatures, and gas-catalyst contact times showed the predominance of the saturated hydrocarbon formation at C_4 and C_5 over the unsaturated ones. Saturate/unsaturate ratios were mostly less than 0.4 and none showed over 0.7.

45504 (N—78-34017) **Radiophysical investigations of Venus from spacecraft.** Kolosov, M.A.; Yakovlev, O.I. Translated from *Zemlya Vselennaya;* No. 3, 33-37(May 1978). 12p. NTIS PC A02/MF A01.

The atmosphere and topography of Venus were studied in detail from the Venera-9 and Venera-10. Research on plasma around the Sun was also carried out. Information on pressure, temperature, and gas composition of the atmosphere in five regions of the planet was obtained. The Venera-9 and Venera-10 transmitted useful information for several months, making a detailed study possible. Radio waves and fluoroscopy were used as the research methods.

45505 (N—78-33643) **Tectonic asymmetry of the earth and other planets.** Pushcharovskii, Y.M.; Kozlov, V.V.; Sulidi-Kondratyev, Y.D. Translated from *Priroda (Moscow);* No. 3, 32-41(Mar 1978). 21p. NTIS PC A02/MF A01.

The structures of Earth, Mars, Venus, and the Moon are examined and compared. Global tectonic characteristics are presented for each. A comparison of the tectonics reveals the structural asymmetry of these planets and the moon. Tectonic asymmetry information for the group is used to interpret certain aspects of the earth's geological past.

ATMOSPHERIC PHYSICS

45506 (N—78-29125) **Space research in the Republic of South Africa: report to COSPAR. Annual report.** Hewitt, F.J. (Council for Scientific and Industrial Research, Pretoria (South Africa)). May 1978. 10p. NTIS PC A02/MF A01.

Results are given of various experiments and studies conducted in the areas of solar—terrestrial physics and satellite remote sensing. Programs in ionospheric sounding, geomagnetism, cosmic rays, and whistlers, VLF, ELF, and auroral emissions are included along with satellite remote sensing of oceanographic parameters. Image processing of LANDSAT data to provide information for forest mapping, antarctic mapping, agricultural land use, and the study of coastal areas is summarized.

AURORAL AND IONOSPHERIC PHENOMENA

45507 (AD-A—058090) **Electron precipitations and polar auroras.** Meng, C.I. (California Univ., Berkeley (USA). Space Sciences Lab.). Apr 1978. Contract F49620-78-C-0035. 134p. NTIS PC A07/MF A01.

In the first part a brief historical review of the progress of our knowledge of the precipitation of auroral electrons is given. Observations by different techniques, in terms of detectors aboard balloons, sounding rockets, and polar-orbiting satellites, are reviewed. The precipitation morphology is examined in terms of synoptic statistical results and of latitudinal survey along individual satellite passes. In the second part, a large number of simultaneous observations of auroras and precipitating auroral electrons by DMSP satellites are examined in detail, and it is shown that precipitation characteristics of auroral electrons are distinctly different for the discrete aurora and the diffuse aurora. In the third part, the source region of auroral electrons is discussed by comparing the auroral electron precipitation at low altitudes observed by DMSP satellites with the simultaneous ATS-6 observations near the magnetospheric equatorial plane approximately along the same geomagnetic field line. It is shown that the diffuse aurora is caused by direct dumping of the plasma sheet electrons from the equatorial region, whereas discrete auroras require acceleration of electrons between the plasma sheet and the polar atmosphere. The parallel electric field along the geomagnetic field line above the ionosphere is a likely candidate for the acceleration mechanism.

45508 (N—78-29665) **Energetic particles and ionization in the nighttime middle and low latitude ionosphere.** Voss, H.D.; Smith, L.G. (Illinois Univ., Urbana (USA). Aeronomy Lab.). 1 Nov 1977. Contract NGR-14-005-181. 323p. NTIS PC A14/MF A01.

Seven Nike Apache rockets, each equipped with an energetic particle spectrometer (12 E 80 keV) and electron-density experiments, were launched from Wallops Island, Virginia and Chilca, Peru, under varying geomagnetic conditions near midnight. At Wallops Island the energetic particle flux (E 40 keV) is found to be strongly dependent on Kp. The pitch-angle distribution is asymmetrical about a peak at 90 D signifying a predominately quasi-trapped flux and explaining the linear increase of count rate with altitute in the altitude region 120 to 200 km. The height-averaged ionization rates derived from the electron-density profiles are consistent with the rates calculated from the observed total particle flux for magnetic index Kp 3. In the region 90 to 110 km it is found that the nighttime ionization is primarily a result of Ly-beta radiation from the geocorona and interplanetary hydrogen for even very disturbed conditions. Below 90 km during rather disturbed conditions energetic electrons can be a significant ionization source. Two energetic particle precipitation zones have been identified at midlatitudes.

45509 (N—78-29672) **Nonlinear Landau damping in the ionosphere.** Kiwamoto, Y.; Benson, R.F. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 35p. NTIS PC A03/MF A01.

A model is presented to explain the non-resonant waves which give rise to the diffuse resonance observed near 3/2 f/sub/H by the Alouette and ISIS topside sounders, where f/sub/H is the ambient electron cyclotron frequency. In a strictly linear analysis, these instability-driven waves will decay due to Landau damping on a time scale much shorter than the observed time duration of the diffuse resonance. Calculations of the nonlinear wave particle coupling coefficients, however, indicate that the diffuse resonance wave can be maintained by the nonlinear Landau damping of the sounder-stimulated 2f/sub/H wave. The time duration of the diffuse resonance is determined by the transit time of the instability generated and nonlinearly maintained diffuse resonance wave from the remote short-lived hot region back to the antenna. The model is consistent with the Alouette/ISIS observations, and clearly demonstrates the existence of nonlinear wave-particle interactions in the ionosphere.

45510 (N—78-29676) **Ionospheric electrical fields .** Kirchhoff, V.W.J.H. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Oct 1977. 26p. NTIS PC A03/MF A01.

The properties and origin of the ionospheric electric fields are reviewed. The early theoretical calculations of electric fields, based on the geomagnetic variations, are discussed, as well as the most recent measurements made by various techniques. Some of the most striking effects caused by ionospheric electric fields are pointed out.

45511 (N—78-33285) **Multifrequency riometer measurements at high latitudes.** Ranta, H.; Ranta, A. (Geofysikaalinen Observatorio, Sodankyla (Finland)). Sep 1978. 13p. NTIS PC A02/MF A01.

The diurnal variation of the radio wave absorption measured by a riometer is the same kind at the frequencies 20 MHz, 27.6 MHz, 40 MHz and 50 MHz at the high-latitude station Sodankyla (L=5.1) having two maxima, the one at midnight and another one in the morning side. The variation of n in the equation $_1 A/_2 A = (f_2/f$ sub 1)n, where A = radio wave absorption (db) and f = used frequency, is studied. The daily and seasonal variation of n shows that n is smaller under sunlit conditions than during darkness, lence ionization is lower under sunlit conditions. No difference could be observed in comparing the values of n caused by precipitated electrons to nightside to those causing ionization in the dayside, thus, the energies of those particles ionizing the D region in the nighttime and daytime do not differ enough to be detected by this experiment.

45512 (N—78-33649) **The onset of an auroral absorption substorm.** Banta, H. (Geofysikaalinen Observatorio, Sodankyla (Finland)). Aug 1978. 14p. NTIS PC A02/MF A01.

The features of the breakups of auroral absorption substorms are discussed. In the longitudinal sector where the substorm breaks up, a sharp onset is preceded by weak absorption which intensifies as it moves equatorwards. The maximum value of absorption after the onset depends on the intensification of the equatorwards moving absorption preceding the breakup. It seems that before the onset the weak absorption decreases to a minimum just before the onset. At longitudes near the breakup a sharp onset can be seen without any preceding absorption, or the minimum of the absorption preceding the onset lasts longer.

45513 (N—78-33650) **Studies of the onset of an auroral absorption substorm.** Ranta, A.; Ranta, H. (Geofysikaalinen Observatorio, Sodankyla (Finland)). Sep 1978. 16p. NTIS PC A02/MF A01.

The breakup of an auroral absorption substorm is discussed using riometer data of the Northern Hemisphere. In the longitudinal sector where the substorm breaks up, a sharp onset is preceded by a weak absorption which intensifies as it moves equatorward. The intensification factor of a weak equatorward moving absorption is considered.

45514 (N—78-33651) **Some properties of high-latitude sporadic E.** Turunen, T. (Geofysikaalinen Observatorio, Sodankyla (Finland)). Sep 1978. 18p. NTIS PC A02/MF A01.

Ionospheric data indicate that three different sporadic E phenomena occur in the auroral zone. In summertime, midlatitude types of sporadic E are seen. These occur in two waves of sequential sporadic E with the first wave in the morning and the second wave in the evening. The evening wave is stronger than the morning wave. Auroral zone types of sporadic E occur throughout the yea

in the evening and nighttime hours. The blanketing frequency of these layers increases at the onset of auroral substorms or even a little before. The maximum is reached rapidly. The decay phase is relatively slow. Auroral particle precipitation, which is related to diffuse auroral illumination, seems to control the blanketing frequency of these layers. Weak diffuse echo from the lower boundary of the E layer is always seen in summer if high gain is used in soundings and noise level is low. The echo, which resembles low type sporadic E echo, never blankets and should not be counted as sporadic E.

45515 (N—78-33652) **High-latitude ionospheric studies in Finland.** Turunen, T. (Geofysikaalinen Observatorio, Sodankyla (Finland)). Sep 1978. 27p. NTIS PC A03/MF A01.

Ionospheric riometer data, data from different beacon satellite experiments, and some theoretical work are reported on radiowave propagation in the complicated polar ionosphere. The phenomena in the lower ionosphere, at D- and E-layer heights, was extensively studied, and the general long-and short-term variations of various parameters were established. Much attention was given to the effects of magnetic activity.

EFFECTS OF NUCLEAR DETONATIONS

45516 Atmospheric nuclear tests of the 1950's and 1960's: A possible test of ozone depletion theories. Chang, J.S.; Duewer, W.H.; Wuebbles, D.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Geophys. Res.;* **84**: No. C4, 1755-1765(20 Apr 1979).

It will be shown that the model chemistries used to calculate the effects of supersonic transports for Climatic Impact Assessment Program and National Research Council studies and of large-scale nuclear exchanges for National Research Council studies cause our one-dimensional model to predict ozone depletions in 1963—1964 resulting from NO/sub x/ injected into the stratosphere by the atmosphere nuclear tests of 1956—1962 larger (4—14% ozone reduction in 1963) than is easily consistent with observation. However, calculations carried out with more recent model chemistries result in ozone reductions that are more easily consistent with observation.

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 45515

45517 (N—78-29126) **Canada report to COSPAR.** (National Research Council of Canada, Ottawa, Ontario). 1978. 32p. NTIS PC A03/MF A01.

Activities of the Canadian Government in the exploration and peaceful use of space are described with emphasis on magnetospheric studies and other international investigations, such as those to be conducted on space shuttle and Spacelab. Research projects being conducted at twelve university centers in support of these programs are reviewed.

45518 (N—78-33339) **Early results from ISEE-A electric field measurements.** Heppner, J.P.; Maynard, N.C.; Aggson, T.L. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1978. 22p. NTIS PC A02/MF A01.

In the solar wind and in middle-latitude regions of the magnetosphere, spacecraft sheath fields obscure the ambient field under low plasma flux conditions such that valid measurements are confined to periods of moderately intense flux. Initial results show: (1) that the DC electric field is enhanced by roughly a factor of two in a narrow region at the front, increasing B, edge of the bow shock, (2) that scale lengths for large changes in E at the subsolar magnetopause are considerably shorter than scale lengths associated with the magnetic structure of the magnetopause, and (3) that the transverse distribution of B-aligned E-fields between the outer magnetosphere and ionospheric levels must be highly complex to account for the random turbulent appearance of the magnetospheric fields and the lack of corresponding time-space variations at ionospheric levels. Spike-like, non-oscillatory, fields lasting less than 0.2 seconds are occasionally seen at the bow shock and at the magnetopause and also intermittently appear in magnetosheath and plasma sheet regions under highly variable field conditions.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

45519 (BNL—26212) **High energy atomic physics program at Brookhaven National Laboratory.** Jones, K.W.; Johnson, B.M.; Gregory, D.C. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 10p. (CONF-790438—3). Dep. NTIS, PC A02/MF A01.

From DOE/BES research meeting on high energy atomic physics; Manhattan, KS, USA (5 Apr 1979).

Research on radiation emitted or produced by beams of swift heavy ions when they interact with a target is summarized.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 45534, 45677

45520 Microsecond operation of a general purpose pulsed proton gun. Humphries, S. Jr.; Kuswa, G.W. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Appl. Phys. Lett.;* **35**: No. 1, 13-16(1 Jul 1979).

A magnetically insulated pulsed proton gun is described that provides an extracted parallel beam of annular cross section for microsecond pulse lengths. In initial tests, time-averaged currents of 5 kA and current densities of 50 A/cm^2 were achieved with $<$ or $\simeq$200 kV voltage. The behavior of the gun appears to be determined by instabilities of the cathode electron cloud growing over time scales of the order of 0.5 msec to give ion current-density enhancements greater than a factor of 50 above the Child-Langmuir limit.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 45690

45521 (LBL—8948) **Studies of electron correlation in the photoionization process.** Rosenberg, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 200p. Dep. NTIS, PC A09/MF A01.

Thesis.

Electron correlation is a result of the interaction of two or more electrons confined in a region of space, and may conveniently be treated under the formalism of configuration interaction (CI). Photoionization provides a rather direct experimental method for studying CI. The types of CI involved in the photoionization process can be divided into three categories: initial-state configuration interaction (ISCI), final-ionic-state configuration interaction (FISCI), and continuum-state configuration interaction (CSCI). The photoelecton spectroscopy of Ba, Sm, Eu, and Yb was studied using both HeI (22.22 eV) and NeI (16.85 eV) radiation. Satellite structure observed in these spectra using NeI (and for Yb, HeI also) radiation could be satisfactorily explained by ISCI alone. The HeI spectra of Sm, Eu, and, in particular, Ba showed dramatic changes in the satellite population which could only be explained by autoionization, a special form of CSCI. The detailed nature of this mechanism was explored in Ba with synchrotron radiation. It was found that the autoionizing level decays preferentially via an Auger-type mechanism. Further insight into autoionization was gained in the electron impact/ejected electron spectra of Ba ($5p^6 6s^2$) and Yb ($5p^6 4f^{14} 6s^2$). Autoionizing levels excited above the first $(5p)^{-1}$ threshold decayed primarily in a two-step Auger process, leading to a relatively large number of doubly charged ions. For autoionizing states below the $(5p)^{-1}$ limit, decay appears to go to ground and excited states of the singly charged ion. The first experimental determination of the lifetime of the XeII 5s5p^6 ^{2}S/sub 1/2/ state yielded a value of 34.4(6) ns. Reasonable agreement with theory could only be reached by including both FISCI and relativistic effects in calculating the lifetime. 173 references, 43 figures, 10 tables.

45522 Resonance absorption measurements of atom concentrations in reacting gas mixtures. I. Shapes of H and D Lyman-α lines from microwave sources. Lifshitz, A.; Skinner, G.B.; Wood, D.R. (Departments of Chemistry and Physics, Wright State University, Dayton, Ohio 45435). *J. Chem. Phys.;* **70**: No. 12, 5607-5613(15 Jun 1979).

Profiles of the Lyman-α lines of H and D emitted from microwave discharges in H_2—D_2—He mixtures, using 0.01, 0.1 and 1% H_2 and D_2 in lamps of three configurations, have been measured at high spectral resolution. Under most of the conditions studied, substantial self-absorption and line reversal were observed. Representative plasma temperatures have been measured from the profiles of the Balmer-α and -β lines. Lyman-α profiles have been modeled using two parameters (taking into account self-absorption in the plasma and between the plasma and the lamp window) along with the plasma temperature. This information is valuable for calibrations and in the choice of operating conditions in resonance absorption and fluorescence measurements of H and D atoms.

45523 Resonance absorption measurements of atom concentrations in reacting gas mixtures. II. Calibration of microwave sources over a wide temperature range. Chiang, C.; Lifshitz, A.; Skinner, G.B.; Wood, D.R. (Departments of Chemistry and Physics, Wright State University, Dayton, Ohio 45435). *J. Chem. Phys.;* **70**: No. 12, 5614-5622(15 Jun 1979).

A series of experiments was carried out to calibrate three different microwave discharge lamps for analysis for D or H atoms,

using Lyman-α absorption. Known concentrations of D atoms were produced in a shock tube by the reaction of 0.05—4 ppm D_2 with N_2O in argon at 1800—3000 K. H atoms were produced by dissociation of 2,2,3,3-tetramethylbutane (10 ppm in argon) at 980—1140 K. These absorption data were compared with the absorption calculated from Lyman-α line shapes reported in an earlier paper, good agreement being found. These experiments provide a sound basis for obtaining the temperature and concentration dependence of the absorption coefficient over a wide temperature range, for H and D concentrations between 10^{-12} and 10^{-10} mole/cc (for a 7.5 cm light path).

45524 Upper and lower bounds on the F_5S—F bond energy. Kiang, T.; Estler, R.C.; Zare, R.N. (Department of Chemistry, Stanford University, Stanford, California 94305). *J. Chem. Phys.;* 70: No. 12, 5925-5926(15 Jun 1979).

The upper and lower bounds for the F_5S-F bond energy based on the chemiluminescent reaction of SF_6 with metastable Ca and Sr atoms are reported. These observations were made under single-collision conditions. AIP

45525 Laser spectroscopy of neptunium; first ionization potential, lifetimes and new high-lying energy levels of Np I. Worden, E.F.; Conway, J.G. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Opt. Soc. Am.;* 69: No. 5, 733-738(May 1979).

The first ionization potential of neptunium has been determined from the photoionization threshold and from Rydberg series observed by laser spectroscopy techniques. The Rydberg series convergence limits yield the most accurate value of 50 536(4) cm^{-1} [6.2657(5) eV]. The radiative lifetimes of five levels in the 26 200—29 050-cm^{-1} range have been measured. New energy levels, 27 odd and 37 even, in the 33 000—37 000-cm^{-1} range have been determined with approximately +- 0.5-cm^{-1} precision.

45526 Opto-galvanic spectroscopy in a uranium hollow cathode discharge. Keller, R.A.; Engleman, R. Jr.; Zalewski, E.F. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Opt. Soc. Am.;* 69: No. 5, 738-742(May 1979).

Laser induced impedance changes in a hollow cathode discharge containing sputtered uranium atoms were used for standard spectroscopic measurements, the determination of oscillator strengths, the measurement of the electron temperature of the discharge, isotope ratio analysis, and obtaining information about the sputtering process. Concentrations of uranium atoms as small as 10^9/cc could be detected.

45527 Determination of the cross sections for metastability exchange in the He^3—He^4 mixture from coherent transfer in the 2^3S_1 state. Zhitnikov, R.A.; Kartoshkin, V.A.; Klement'ev, G.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* 4: No. 11, 518-519(Nov 1978).

Magnetic resonance measurements are used instead of the usual line width technique to determine the cross sections at 220°K. (AIP)

45528 Highly excited states of the hydrogen atom in an electric field. Drukarev, G.F. (A. A. Zhdanov Leningrad State University). *Sov. Phys. - JETP (Engl. Transl.);* 48: No. 2, 237-242(Aug 1978).

We discuss the levels E and their widths Γ of hydrogen atom in the quasiclassical approximation in the presence of a uniform electric field E (all quantities are in atomic units). The effective quantum number ;= (—2E)/sup -1/2/ depends on E and on the parabolic quantum numbers n_1, n_2, and vertical-barmvertical-bar. For vertical-barmvertical-bar very-much-less-thann/sub 1,2/ the ratio ν/n (n is the principal quantum number) With accuracy to quantities of order $(m/n)^2$ is a universal function of two parameters: S= $(n_1—n_2)/n$ and T=$4n^4$ E. The value of ν/n is determined by Eqs. (3.4) — (3.6) and the value of Γ by Eq. (5.8). The values obtained with these relations is close to the results obtained by numerical integration of the Schroedinger equation.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

45529 (CALT—63-295) Variations of nuclear charge radii in mercury isotopes with A = 198, 199, 200, 201, 202, and 204 from x-ray isotope shifts. Lee, P.L.; Boehm, F.; Hahn, A.A. (California Inst. of Tech., Pasadena (USA); California State Univ., Northridge (USA)). 1977. Contract EY-76-C-03-0063. 14p. Dep. NTIS, PC A02/MF A01.

The isotope shifts of atomic K x rays were measured for pairs of the six mercury isotopes with A = 198, 199, 200, 201, 202, and 204, using a curved crystal spectrometer. The changes of the nuclear charge radii were derived in terms of δ $< r^2 >$ and δ R/sub k/ and compared with optical and muonic isotope shift data. From results, a renormalization of the optical data was obtained. 11 references.

45530 (CALT—63-300) Cascade of negative muons in atoms. Akylas, V.R. (California Inst. of Tech., Pasadena (USA)). 1978. Contract EY-76-C-03-0063. 80p. Dep. NTIS, PC A05/MF A01.

Thesis. Portions of document are illegible.

A study is made of the evolution of a negative muon captured in an atom and the formalism of energy loss associated with the muonic atom. The principal goals are to calculate reliability the muon x-ray intensities, given the initial population of the muonic orbits, to invert the problem and deduce the initial distribution from the x-ray intensities, to provide a reasonably simple and convenient tool to correlate observations, and finally, to systematize some questions of theoretical interest. The early part of the history of the muon in matter, including the atomic capture and classical phase of the atomic cascade are reviewed. In the quantal treatment of the transition rates, both radiative and electron Auger transitions are considered. In general, multipolarities up to E3 and K, L, and M electronic shells are fully investigated. Multipole radiation is treated in the conventinal way and pesents no special problems. Magnetic type transitions between states with different principal quantum numbers are shown to be small. Auger electron ejection rates are more complicated and several approximations have been adopted. The basic results have been computed in terms of elemetary functions. In the Auger transitions we have shown that magnetic multipoles can be safety neglected. The relative sizes of the rates corresponding to different multipoles are systematically studied. A comparison of results is made with atomic photoelectric effect data and with the nuclear internal conversion coefficients. A general agreement is found, except around shell thresholds. The existing data of muonic x-ray intensities in iron and thallium are analyzed in a systematic way. It is found that for Fe the initial l-distribution is almost flat, whereas that for T1 is weighted towards the high l values, sharper than statistical. As a result of the investigations and in order to make our findings usable, a computer program has been developed. 36 references.

45531 (CONF-790437—7) Supercell calculations of positron trapping and annihilation at vacancies in simple and transition metals. Gupta, R.P.; Siegel, R.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

A new approach, based upon augmented-plane-wave calculations in a supercell lattice, was developed to theoretically predict the annihilation characteristics of the positron in vacancies, taking into account for the first time the atomic nature of the solid. This method, which is general and suited equally well to both simple and transition metals, was used to calculate positron trapping and annihilation characteristics in Al, Nb, Ta, and W. The results indicate that the positron is sufficiently strongly trapped in a vacancy in all of these metals that significant thermal detrapping in any of them is highly unlikely. 13 references.

45532 Orthopositronium decay into axions. Mikaelian, K.O. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Phys. Lett., B;* 77: No. 2, 214-216(31 Jul 1978).

It is pointed out that if the mass of the hypothetical particle called the axion is less than 2msub(e), then it can be emitted in the decay of orthopositronium. The lifetime of the decay $1^3S_1 \rightarrow \gamma h$ is calculated to be about 8s. An experiment to look for 'single' photons from positronium annihilation is suggested. An accurate measurement of the energy Esub(γ) of these photons gives the mass of the axion through the relation msub(axion)^2 = 4 msub(e)(msub(e) - Esub(γ)).

45533 Measuring macroscopic diffusion of positive muons in metals. Leon, M.; Heffner, R.H. (Los Alamos Scientific Lab., NM (USA)). *Phys. Lett., A;* 69: No. 3, 235-238(11 Dec 1978).

A technique is proposed for measuring the diffusion of positive muons in metals, using macroscopic diffusion across plane boundaries. Expressions for the muon asymmetry as a function of time are derived for the configurations suggested.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 45672

45534 (ORO—6036-1) X-ray emission in heavy-ion collisions. Progress report, July 1, 1978—June 30, 1979. Watson, R.L. (Texas A and M Univ., College Station (USA). Cyclotron Inst.). Apr 1979. Contract ER-78-S-05-6036. 75p. Dep. NTIS, PC A04/MF A01.

Studies of spectra of x-rays produced in heavy-ion collisions are reported. The aims of these studies are: (1) to attain a better understanding of the mechanisms for multiple inner-shell ionization of target atoms; (2) to characterize the fast rearrangement processes that occur following multiple inner-shell ionization; (3) to utilize Kα x-ray satellite and hypersatellite structure to study the equilibration of inner-shell vacancy states in fast ions penetrating solid targets; and

(4) to investigate the effects of surface interactions on the polarization of x-rays emitted by highly stripped ions emerging from thin foils. A summary of studies in each of these areas is presented. (GHT)

45535 Coupled-channel study of halogen (^2P) + rare gas (^1S) scattering. Becker, C.H.; Casavecchia, P.; Lee, Y.T.; Olson, R.E.; Lester, W.A. Jr. (Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* 70: No. 12, 5477-5488(15 Jun 1979).

Quantum mechanical coupled-channel (CC) scattering calculations are reported using realistic adiabatic potentials for the $^2P+^1S$ interaction of F—Ar, F—Xe, and Cl—Xe. Differential cross sections $d\sigma/d\omega$ derived from a simple elastic approximation appropriate for large spin—orbit interactions accurately reproduce all the gross features computed by the coupled-channel method. This finding supports the extraction of interaction potentials from laboratory differential cross sections I (θ) via an elastic analysis. Integral inter- and intramultiplet changing cross sections are expressed conveniently in terms of Grawert's B(j, j';g) coefficient. Information on the collision dynamics is extracted by following the partial wave dependence of selected B(j, j';g). Classical turning point analysis, based on the values of the large l-waves for which these partial wave contributions B/sub l/(j, j';g) begin to rise above zero, leads to the conclusion that both intermultiplet and first order forbidden intramultiplet transitions are caused by a single localized nonadiabatic coupling region at the position of complex crossing of the $\Omega=1/2$ adiabatic potentials. Small amplitude oscillations or perturbations in the CC calculated $d\sigma/d\omega$ and in the experimental I (θ) are thought to be examples of Stuekelberg oscillations, though quantitative agreement between these quantities is not ob

45536 Temperature effect on the collision-induced emission of S(^{1}S) with He, Ar, N_2, H_2, Kr, and Xe. Black, G.; Sharpless, R.L. (Molecular Physics Laboratory, SRI International, Menlo Park, California 94025). *J. Chem. Phys.;* 70: No. 12, 5571-5574(15 Jun 1979).

Collision-induced emission from S(^{1}S) has been studied in collisions with He, Ar, N_2, H_2, Kr, and Xe at 232 and 425°K. The S(^{1}S) was made by OCS photodissociation at 157.7 nm. These results, in conjunction with an earlier study at 296°K, show the importance of bound molecules in the collision-induced emission with Xe: a dissociation energy of ≃0.06 eV is estimated for the 2 $^1\Sigma^+$ potential of XeS [the potential arising from Xe+S(^{1}S)]. Evidence for collision-induced emission from bound molecules is found for all except He. In contrast to the other gases, collision-induced emission is a minor process in the removal of S(^{1}S) by hydrogen, accounting for only 0.36% of quenching collisions at 232°K decreasing to 0.12% at 425°K.

45537 Formation of He^+ ions in various electronic states in He^{+2} + He collisions. Afrosimov, V.V.; Basalaev, A.A.; Leiko, G.A.; Panov, M.N. (A. F. Ioffe Physicotechnical Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* 47: No. 5, 837-842(May 1978).

One-electron capture ($He^{+2}+He \rightarrow He^+ + He^+$) and capture with ionization ($He^{+2}+He \rightarrow He^+ + He^{+2} + e^-$) in He^{+2} + He collisions have been investigated for He^{+2} kinetic energies T_0 from 2 to 60 keV. To recognize the processes, both particles from a given collision were recorded by a coincidence technique. For the first time ever, the charge states of the particles were analyzed and the kinetic energy losses and scattering angle of the fast particle were measured for the same collisions. This made it possible to measure the cross sections for elementary processes involving changes in the charge states with the production of particles in definite electronic states and taking place at a fixed impact parameter. It is shown that in the capture process one of the He^+ ions is formed in an excited state with overwhelming probability (~75% at $T_0=60$ keV and nearly 100% at $T_0=2$ keV). The energy distributions of the electrons released in capture-with-ionization processes corresponding to definite impact parameters were determined. The impact-parameter dependence of the distributions shows that the capture-with-ionization process is a result of the decay of an autoionization state of the He^{+2}_2 quasimolecule. The internuclear distances at which the inelastic transitions take place (as determined from the scattering of the fast He^+ ions) agree with those exp

ATOMIC AND MOLECULAR THEORY

45538 (BNL—26068) Collective effects, relaxation and localization of hole levels in atoms, molecules, solids, and adsorbates. Wendin, G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 26p. (CONF-790368—2). Dep. NTIS, PC A03/MF A01.

From Sanibel symposium on quantum chemistry and solid state physics; Palm Coast, FL, USA (12 Mar 1979).

Recent progress in descriptions of photoelectron spectra is reviewed with emphasis on cases where the one-electron and quasi-particle approximations break down and the hole level becomes spread over a number of discrete lines or a continuum or both. Unifying aspects and similarities between interaction processes in atoms, molecules and solids are stressed. 38 references.

45539 Spin-adapted vector method: An alternative to the conventional configuration interaction approach. Bender, C.F. (Chemistry and Materials Science Department, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Comput. Phys.;* 30: No. 3, 324-332(Mar 1979).

A number of refinements have been incorporated in the vector method. The refinements include utilization of spin-adapted configurations, partitioning the steps in the calculation, and determining the connection of this spin-adapted vector method and standard configuration interaction techniques. To this end, the spin-adapted vector method can be used to generate an integral inverted formula tape commonly used by standard configuration interaction. Sample calculations on LiH are used to compare standard CI and the spin-adapted vector method.

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 45104

45540 (M—101) OASIS: a general purpose mesh generator for finite element codes. Gerhard, M.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Apr 1979. Contract W-7405-ENG-48. 89p. Dep. NTIS, PC A05/MF A01.

OASIS is a general-purpose mesh generator for two- and three-dimensional finite element codes. The basic parts of OASIS are the surface generator and the three-dimensional region generator, both of which use a linear-blending interpolation formula. Two coordinate systems ae used, integer space and geometric space. Integer space is defined by a right-handed coordinate system (I, J, K), and represents rectangles in two dimensions (2D) and rectangular prisms in three dimensions (3D). A node in integer space has three integer coordinates. On the other hand, geometric space is defined by a right-handed orthogonal coordinate system (X, Y, Z); the structure actuaoly exists in geometric space. In 2D, OASIS is able to generate triangular transitional elements, 4-node isoparametric elements, 5-to-9 node continuum elements, bars and beams. In 3D, OASIS can generate 8-node isoparametric elements as well as 9-to-27 node continuum elements and trusses. In 2D, a standard quad element may degenerate into a triangle. In 3D, a standard brick may degenerate into a triangular pyramid. In both 2D and 3D, displacement, rotation, and traction boundary conditions may be applied. 28 figures.

SUPERFLUIDITY

45541 Critical velocities of vortex formation and equilibrium vortex density in rotating He II. Krasnov, Y.K.; Matyushkina, L.V. (Physics Institute, Academy of Sciences of the Georgian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* 4: No. 11, 660-663(Nov 1978).

The interaction of Onsager—Feynman vortices with the walls of a rotating vessel containing He II results in the formation of a surface-energy barrier which prevents the vortices from entering the bulk of the fluid, in much the same way as the Been—Livingston barrier obstructs Abrikosov vortices in type-II superconductors. It is shown that taking this barrier into account appreciably changes the criterion for the critical velocity of vortex formation which proves to depend substantially on the roughness of the vessel walls. A correction is calculated for the equilibrium vortex density in uniformly rotating He II due to the existence of the surface barrier.

45542 Hydrodynamics of superfluid systems, with consideration of ponderomotive forces. Shevchenko, S.I. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* 4: No. 11, 663-669(Nov 1978).

A complete system of equations is constructed for the hydrodynamics of superfluid systems, with consideration of the effects of polarization of the liquid by electromagnetic fields. It is shown by means of the equations obtained, that crossed electric and magnetic fields must cause the appearance of superfluid currents, in helium-II, the velocity which is v/sub s/= (α/Mc)[E x H] (α is the polarizability of the helium atom and M is its mass). If the helium is in a cylindrical container, between the outer (radius R_2) and inner (radius R_1) walls of which is created a potential difference U, and a magnetic field H is applied parallel to the axis of the cylinder, then these currents correspond to the ground state of the system with the condition that $Phi/Phi_0=1/2$. Here the quantum of the current $Phi_0=hc/2e$, and $Phi<2\pi R\alpha UH/2eR \ln(R_2/R_1)$ is the flow between the cylindrical surfaces, separated from one another by the magni-

tude of the shift $\alpha U/2eR \ln(R_2/R_1)$ of the electron distribution as a result of polarization.

45543 Quantized vortices and spikes in the dielectric susceptibility of He II in crossed fields. Shevchenko, S.I. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **4**: No. 11, 694-695(Nov 1978).

The critical voltage at which a new quantum causes a spike in the susceptibility is calculated.

45544 Vortex motion in uniformly and nonuniformly rotating helium II. Kiknadze, L.V.; Mamaladze, Yu.G. (Physics Institute, Georgian Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **48**: No. 2, 305-310(Aug 1978).

The equations of motion of the vortices produced in the superfluid component of helium II and interacting with its normal component are used for the analysis of the self-acceleration of a decelerating vessel with helium or of a pulsar. It is shown that in this case the vortices transfer the angular momentum to the vessel gradually, during the course of their motion to the walls, a process that ends in annihilation of the already "exhausted" vortex; the annihilation speeds up sharply immediately before the acceleration, but its integrated value is small. Computer experiments have refined the detail of this process, and confirmed as well as the Khalatnikov formula for the width of the irrotational region in a uniformly rotating vessel.

45545 He^3—He^4 solutions and other low-density Fermi liquids in a magnetic field. Bashkin, E.P.; Meierovich, A.E. (Institute of Physics Problems, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **47**: No. 5, 992-1000(May 1978).

A theory is proposed for a Fermi liquid of low density, such as a solution of He^3 in superfluid He^4, in an arbitrary magnetic field. The characteristics of the solution are determined by an expansion in the concentration x/sup 1/3/ and are specified, in a field that is not too strong, by a single parameter, the s-scattering length. At almost total polarization of the spin system, the main contribution is already made by p-scattering. Values are obtained for the thermodynamic and hydrodynamic quantities and for the propagation velocity of the low-frequency oscillations (transverse spin waves, high-frequency first sound, and coupled spin-sound modes that exist in weak magnetic fields). The most noticeable are the magnetokinetic effects connected with the appreciable growth of the fermion mean free path and of the kinetic coefficients.

OTHER QUANTUM FLUIDS

REFER ALSO TO CITATION(S) 45690

45546 Monte Carlo calculation of the radial distribution function of quantum hard spheres at finite temperatures. Whitlock, P.A.; Kalos, M.H. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). *J. Comput. Phys.;* **30**: No. 3, 361-388(Mar 1979).

The Green's function Monte Carlo method is generalized to treat quantum systems at non-zero temperature. The algorithm that is developed absolutely requires importance sampling to make it feasible. The nature of the importance sampling transformation needed for an efficient algorithm is discussed in theory and practice. As a demonstration of the principles, we carry out a calculation of the two body contribution to the radial distribution function and the second virial coefficient of a hard sphere fluid. Accurate numerical results are obtained. It is also shown how improvement in the structure of the importance function can lead to dramatic improvements in computational efficiency. A method is described, and successfully applied, whereby an importance function may be determined in large part during the Monte Carlo, rather than a priori. Finally, we conjecture that importance sampling can also be applied to the sums over permutations for treating boson or fermion systems.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

45547 (SLAC-PUB—2315) Neutral energy production in e^+e^- annihilation. Scharre, D.L. (Stanford Linear Accelerator Center, CA (USA)). Apr 1979. Contract DE-AC03-76SF00515. 5p. (CONF-790365—2). Dep. NTIS, PC A02/MF A01.

From 16. rencontre de moriond; Les Arcs, Savoie, France (17 Mar 1979).

Recent results from SPEAR on inclusive γ and π^0 production in e^+e^- annihilation are presented. These results are inconsistent with expectations based on an earlier analysis of charged particle production in e^+e^- annihilation (assuming all-pion production). A new analysis which incorporates production of heavy particles, resonances, and tau's is presented which adequately describes the available charged and neutral data. 7 references.

45548 Measurement of the pion form factor near the $e^+e^- \rightarrow \pi^+\pi^-$ threshold in colliding electron positron beams. Vasserman, I.B.; Ivanov, P.M.; Koop, I.A.; Lysenko, A.P.; Pestov, Y.N.; Skrinskii, A.N.; Fedotovich, G.V.; Shamovskii, V.G.; Shatunov, Y.M. (Nuclear Physics Institute, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 496-498(Oct 1978).

A time-of-flight technique with a new detector having record time resolution has been used to measure the pion form factor for a colliding-beam energy 2 x 200 MeV. The result vertical-barF/sub π/ vertical-bar=1.3 +- 0.13 agrees with extrapolation of the data from the rho—ω interference region on the basis of the Gounaris-Sakurai formula.

WEAK INTERACTIONS

45549 (COO—3071-236) Neutrino oscillations. Mann, A.K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1978. Contract EY-76-C-02-3071. 13p. (CONF-7804137—1). Dep. NTIS, PC A02/MF A01.

From Clyde L Cowan Memorial symposium on long-distance neutrino detection; Washington, DC, USA (25 Apr 1978).

A summary is presented of various possible and active experiments to search for neutrino oscillations. 15 references.

45550 (LA-UR—79-1441) Neutrino test of muon number conservation and a measurement of the reaction ν/sub e/ + D → p + e^- + p. Nemethy, P.; Willis, S.E.; Hughes, V. (Yale Univ., New Haven, CT (USA); Los Alamos Scientific Lab., NM (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); National Research Council of Canada, Ottawa, Ontario; Schweizerisches Inst. fuer Nuklearforschung, Villigen; Bern Univ. (Switzerland)). 1979. Contract W-7405-ENG-36. 5p. (CONF-790648—1). Dep. NTIS, PC A02/MF A01.

From Neutrino 1979 conference; Bergen, Norway (18 Jun 1979).

To test whether lepton conservation proceeds via a multiplicative law a search was made for the wrong neutrinos (anti ν/sub e/) from μ^+ decay. A six-ton H_2O Cerenkov detector was used to look for the reaction anti ν/sub e/p → e^+n at the LAMPF beam stop. A preliminary limit, R = anti ν/sub e//all μ^+ decay < .07, provides both a stringent limit on multiplicative lepton conservation and a limit on neutrino mass < 1 ev in oscillations ν/sub μ/ → ν/sub e/. By filling the detector with D_2O, the cross-section for the reaction anti ν/sub e/+D→p+e^- +pwas measured and found to be 1.17 +- .32 times the expected value.

45551 Measurement of the structure functions in neutrino and antineutrino inelastic interactions. Benvenuti, A.; Bobisut, F.; Cline, D.; Cooper, P.S.; Gilchriese, M.G.D.; Heagy, B.M.; Imlay, R.; Johnson, M.E.; Ling, T.Y.; Lundy, R.; Mann, A.K.; McIntyre, P.; Mori, S.; Reeder, D.D.; Rich, J.A.; Stefanski, R.; Trinko, T.; Winn, D.R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **42**: No. 20, 1317-1321(14 May 1979).

Measurements of the x distributions from inclusive ν/sub μ/ (nu-bar/sub μ/) reactions are interpreted in the quark-parton model to yield absolutely normalized momentum distributions of valence and sea quarks in the nucleon. The x distributions exhibit a small but significant dependence on energy. From the y distributions we also determine a value of $R = [\int 2xF_1(x)\,dx/\int F_2(x)\,dx]$- 1, averaged over the energy interval 20 to 220 GeV.

45552 Study of neutrino interactions in hydrogen and deuterium. II. Inelastic charged-current reactions. Barish, S.J.; Derrick, M.; Dombeck, T.; Hyman, L.G.; Jaeger, K.; Musgrave, B.; Schreiner, P.; Singer, R.; Snyder, A.; Barnes, V.E.; Carmony, D.D.; Garfinkel, A.F. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **19**: No. 9, 2521-2542(1 May 1979).

This paper gives the results of a study of inelastic charged-current interactions of muon-type neutrinos with hydrogen and deuterium targets using the Argonne 12-foot bubble chamber. We discuss in detail the separation of the events from background. For the single-pion production reactions $\nu p \rightarrow \mu^- p\pi^+$, $\nu n \rightarrow \mu^- n\pi^+$, and $\nu n \rightarrow \mu^- p\pi^0$, energy-dependent cross sections, differential cross sections, invariant-mass distributions, and the $\Delta^{++}(1236)$ decay angular distribution are presented. These data are also used to study the isospin properties of the πN system. Comparisons of the data with models of single-pion production are made, and a direct test of partial conservation of the axial-vector current is discussed. Cross sections and invariant-mass distributions are given for the reactions in which more than one pion is produced. Ten events of strange-particle production were found, and the properties of these events are discussed. The energy dependence of the total νp and νn cross

sections from threshold to 6 GeV was determined, and the $\sigma(\nu n)/\sigma(\nu p)$ ratio measured. This ratio and the inclusive x and y distributions rapidly approach the scaling distributions expected from the quark-parton model.

45553 Measurement of the longitudinal polarization of direct muons produced in NN collisions at p/sub l/=1.9 GeV/c. Abramov, V.V.; Alekseev, A.V.; Bityukov, S.I.; Bondarenko, G.B.; Vrazhnov, Y.N.; Dobretsov, Y.P.; Dolgoshein, B.A.; Dunaitsev, A.F.; Dyshkant, A.S.; Evdokimov, V.N.; Kalinovskii, A.N.; Kantserov, V.A.; Kirillov-Ugryumov, V.G.; Kryshkin, V.I.; Kul'man, N.Y.; Lanshchikov, G.I.; Nevskii, P.L.; Nikitin, Y.P.; Rybakov, V.G.; Sen'ko, V.A.; Somov, S.V.; Spiridonov, A.A.; Sulyaev, R.M.; Sytin, A.N.; Chepegin, V.N. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 498-503(Oct 1978).

An experiment measuring the yield of direct muons and their longitudinal polarization is described. The polarization was determined from the front-back asymmetry in decay of muons stopped in a multilayer scintillation detector placed in a transverse magnetic field and turned out to be eta/sub x/=-0.41 +- 0.17. The ratio μ^+/π^+ was measured in three independent experiments and found to be $(7.0 \pm 1.1) \times 10^{-6}$.

45554 Upper limit on the four photon decay of the neutral pion. Auerbach, L.B.; Highland, V.L.; Johnson, K.F.; McFarlane, W.K. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics); Macek, R.J.; Pratt, J.C. (Los Alamos Scientific Lab., NM (USA)). *Phys. Lett., B;* **78**: No. 2, 353-354(25 Sep 1978).

The authors have searched for the decay $\pi^0 \rightarrow 4\gamma$, and have observed no events. The 90% confidence level upper limit to the branching ratio is found to be 3.8×10^{-5}.

45555 Total cross sections for neutrino and antineutrino interactions in the energy range 3—30 GeV. Moscow—Serpukhov Collaboration. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 214-216(Aug 1978).

The slopes of total cross sections a/sub :/=σ/sub t/(;)/E/sub ν/ = (0.74 +- 0.07 x 10^{-38} $cm^2 x GeV^{-1}$ and a@sub nu-bar@=σ/sub t/(nu-bar)/Enu-bar = (0.31 +- 0.03) +- 0.03) x 10^{-38} $cm^2 x GeV^{-1}$ are obtained for neutrino and antineutrino charged-current interactions in the energy range 3< or =E< or =30 GeV. The ratio of total cross sections is R=σ/sub nu-bar//σ/sub ν/ <0.42 +- 0.03.

STRONG BARYON-INDUCED INTERACTIONS

45556 (LA—7828-T) Neutron—proton radius differences and isovector deformations from π^+ and π^- inelastic scattering from ^{18}O. Iversen, S.G. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 251p. Dep. NTIS, PC A12/MF A01.

Thesis.

Angular distributions were measured for elastic and inelastic scattering of 164 and 230 MeV π^{+-} from ^{18}O. Angular distributions for elastic scattering and for excitation of the 2_1+ transition at 1.98 MeV, the 3_1- transition at 5.10 MeV, and an unresolved triplet of states consisting of the 4_1^+ at 3.56 MeV, the 0_2^+ at 3.63 MeV, and the 2_2^+ at 3.92 MeV are presented. The angular ranges covered are 17.5 to 80° for T/sub π/ = 164 MeV and 17.5 to 70° for T/sub π/ = 230 MeV. In addition 1_1^- transition at 4.45 MeV and several transitions at excitation energies above 6 MeV, but detailed analysis of these transitions was not undertaken. 123 references. (JFP)

45557 Proton polarization in inclusive processes at 100—400 GeV. Polvado, R.O.; Ems, S.C.; Gray, S.W.; Lepore, R.M.; Neal, H.A.; Ogren, H.O.; Rust, D.R.; Walters, G.A. (Department of Physics, Indiana University, Bloomington, Indiana 47045). *Phys. Rev. Lett.;* **42**: No. 20, 1325-1327(14 May 1979).

The results of an experiment conducted at Fermilab to measure the polarization of the final-state proton in the reaction p + p → p/sub arrow-up/ + X and p + C → p/sub arrow-up/ + X are presented. Measurements were made at beam energies of 100, 200, 300, and 400 GeV for P/sub T/ from 0.5 to 1.5 GeV/c and x/sub F/ between -0.7 and -0.9.

45558 Momentum spectra of secondary protons from pp, pd, and pC collisions at 4.3, 6.3, and 8.9 GeV/c. Azhgirei, L.S.; Alaverdyan, G.B.; Vzorov, I.K.; Zhmyrov, V.N.; Ivanov, V.V.; Ignatenko, M.A.; Kuznetsov, A.S.; Lykasov, G.I.; Meshcheryakov, M.G.; Razin, S.V.; Stoletov, G.D. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 515-521(Oct 1978).

A one-arm magnetic spectrometer was used to measure, at an angle 103 mrad, the momentum spectra of the protons emitted in pp, pd, and pC collisions at initial proton momenta 4.3, 6.3, and 8.9 GeV/c. The character of the high-momentum parts of the measured spectra points to an important role of multiple nucleon-nucleon scattering in interactions between protons and nuclei at the indicated initial momenta. The experimental data are described satisfactorily within the framework of the model of multiple diffraction scattering. The sensitivity of the calculated pd spectra to the choice of the wave functions of the initial and final states of the pd system is investigated. Analysis of the low-momentum parts of the measured spectra of the protons from pp collisions at 6.3 and 8.9 GeV/c has yielded the differential cross sections for production of the nucleon resonances N* (1236), N* (1410), N* (1520), and N* (1690).

45559 Search for deuteron knockout from carbon nuclei by 4.3-GeV/c protons. Azhgirei, L.S.; Vzorov, I.K.; Zhmyrov, V.N.; Ivanov, V.V.; Ignatenko, M.A.; Kuznetsov, A.S.; Meshcheryakov, M.G.; Razin, S.V.; Stoletov, G.D. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 522-524(Oct 1978).

The results of a search for deuteron knockout from carbon nuclei at an angle of 103 M rad by 4.3-GeV/c protons are presented. The measured differential cross section for this process is 3.4 +- 2.4μb/sr. The differential cross sections for the reactions pp→dπ^+ and pd→dp and also for the reaction p<N>→dπ on nucleons bound in deuterium and carbon nuclei have been determined under the same experimental conditions. The value of the ratio of the differential cross section for quasielastic deuteron knockout from carbon in the forward direction to that for elastic deuteron production in pd scattering is compared to the value calculated using the distorted-density impulse approximation.

45560 Detection of a ^{12}C hypernucleus in the interaction of 250-GeV protons with emulsion nuclei. Bunyatov, S.A.; Lyukov, V.V.; Sidorov, V.M.; Yarba, V.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 222-225(Aug 1978).

An event that is interpreted as the production and decay of the ground state of the ^{12}/sub Λ/C hypernucleus was found in analyzing 150 000 interactions in an emulsion stack exposed to 250-GeV protons. The charge of the hypernucleus was determined from the measured residual-range dependence of the width of the track. The track of the positron from the beta decay of the ^{12}N recoil nucleus was detected. The binding energy B/sub Λ/ of the λ hyperon in the ^{12}λC hypernucleus was found to be 11.14 +- 0.57 MeV. The accuracy in determining B/sub Λ/ is better by a factor of two than that previously achieved by the missing-mass method using electronics.

45561 Study of the characteristics of interactions of nuclei from high-energy primary cosmic rays with emulsion nuclei using the Intercosmos-6 satellite. Shomodi, A.; Sugar, S.; Chadraa, B.; Basina, Y.V.; Brikker, S.I.; Grigorov, N.L.; Grigor'eva, L.B.; Kondrat'eva, M.A.; Mishchenko, L.G.; Nymmik, R.A.; Papina, L.P.; Podgurskaya, A.V.; Poperekova, L.M.; Rapoport, I.D.; Savenko, I.A.; Sokolov, V.K.; Sobinyakov, V.A.; Tret'yakova, C.A.; Chikova, L.O.; Shestoperov, V.Y.; Shopenberg, Z.M.; Batskan, B.; Neachu, D.; Khaiduk, M.; Vishki, T.; Dubinskii, Y.; Yust, L. (Central Institute of Physical Research, Hungarian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 225-233(Aug 1978).

The experimental data on the characteristics of the interaction of protons, α particles, and heavy nuclei with the nuclei in nuclear emulsion for an average particle energy of ~7 TeV is presented. The data obtained show that the number of particles produced per interacting nucleon of the primary nucleus decreases as the atomic number of the primary nuclei increases. A class of nuclear interactions is discovered which cannot be reduced to the superposition of independently interacting nucleons.

STRONG MESON-INDUCED INTERACTIONS

45562 Production of strange particles in π^-p interactions at 5 GeV/c. Budagov, Y.A.; Vinogradov, V.B.; Volod'ko, A.G.; Gulkanyan, G.R.; Karamyan, Z.K.; Kirakosyan, Z.A.; Lomakin, Y.F.; Flyagin, V.B.; Sandor, L.; Chiladze, B.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 503-507(Oct 1978).

Data are obtained on the multiple production of charged and neutral particles accompanying strange ones in π^-p interactions at 5 GeV/c. A comparison of these data with the corresponding values for reactions without strange particles attests to the similarity of a number of characteristics of the two types of processes. This similarity is observed also in the distributions with respect to associative production of Λ^0 hyperons at 5 GeV/c and at energies > or =40 GeV.

45563 Multinucleon interactions of π^- mesons with carbon nuclei at p=40 GeV/c. Angelov, N.S.; Backovic, S.; Grishin, V.G.; Kanarek, T.; Nagy, Y.; Shabel'skii, Y.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 512-515(Oct 1978).

The experimental data on the multiplicity of secondary particles produced in interactions of π^- mesons with several nucleons of the carbon nucleus at p=40 GeV /c (multinucleon interactions) are compared with calculations with the multiple-scattering model.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

45564 Quantum flavordynamics. Fritzsch, H. (CERN, Geneva, Switzerland). pp 275-322 of Deeper pathways in high-energy physics. Perlmutter, A.; Scott, L.F. (eds.). New York, NY; Plenum Press (1977).

From Conference of the Orbis Scientiae Center for Theoretical Studies; Coral Gables, FL, USA (16 Jan 1977).

The theoretical description of quantum flavordynamics is based on the four quark flavors and the four observed leptons. The neutral current, leptonic neutral current cross sections, new charged currents, the new lepton physics, muon number nonconservation, the naturalness of nature, and beyond SU(2) x U(1) are treated. It is observed that it is at present unclear what the final theory of flavordynamics will be since there are too many unanswered questions in particular, charge quantization and symmetry breaking. 97 references. (JFP)

45565 (ORO—3992-362) **Research program in elementary particle theory. Progress report, 1978—1979.** Sudarshan, E.C.G.; Ne'eman, Y. (Texas Univ., Austin (USA). Center for Particle Theory). 1979. Contract EY-76-S-05-3992. 79p. Dep. NTIS, PC A05/MF A01.

Theoretical high energy physics research is summarized. A list of publications including a list of DOE reports issued is included. (JFP)

45566 Generalization of the Glashow-Iliopoulos-Maiani mechanism: Horizontal and vertical flavor mixing. Georgi, H.; Pais, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., D;* **19**: No. 9, 2746-2754(1 May 1979).

For theories with more than four quarks we generalize the Glashow-Iliopoulos-Maiani mechanism for flavor-change suppression in the gauge sector and the Glashow-Weinberg theorems for the corresponding suppression in the Higgs sector. We note that there is a class of theories in which many but not all flavor changes are naturally suppressed. d bold-arrow-left-right s and u bold-arrow-left-right c are in the naturally suppressed category. Such theories have distinctive experimental signatures. We discuss the simplest example where the new mechanism applies: SU(3) x U(1) with six quarks, two with charge 2/3, four with charge -1/3. We also indicate how this six-quark system can be incorporated in a full-fledged gauge theory.

ELECTROMAGNETIC INTERACTIONS

45567 SU(4) x U(1) gauge theory. I. Muon-number nonconservation. Deshpande, N.G.; Hwa, R.C.; Mannheim, P.D. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Phys. Rev., D;* **19**: No. 9, 2686-2702(1 May 1979).

This is the first in a series of three papers in which we study a unified gauge theory based on the group SU(4) x U(1). In this paper we present the general group-theoretical structure of SU(4) x U(1) and study in particular the muon-number-nonconserving processes which occur in the model. In the subsequent papers we shall study CP violation and present a new approach to understanding the Cabibbo angle. The central theme of our work is that all of the phenomena discussed in this series can be understood through the spontaneous-breakdown mechanism. In this paper we construct an explicit Higgs potential which breaks SU(4) x U(1) down to the usual SU(2) x U(1) theory of Weinberg and Salam. Of particular interest in this paper are rare muon-number-nonconserving processes, such as $\mu \rightarrow e\gamma$, which are forced to take place in our model once the symmetry has been broken. Our model possesses 12 new heavy intermediate vector bosons, and the available experimental constraints on their masses are presented.

45568 Position of the pole of the amplitude M_1/sub +//sup 3/2/ of the reaction $\gamma p \rightarrow N\pi$. Miroshnichenko, I.I.; Nikiforov, V.I.; Sanin, V.M.; Sorokin, P.V.; Shalatskii, S.V. (Khar'kov Physicotechnical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 197-198(Aug 1978).

Estimates of the Δ^+-isobar mass $M_0 = 1208.5 +- 0.72$ MeV and of its total width $\Gamma_0 = 113.9 +- 2$ MeV were obtained for the first time ever from the coordinates of the pole of the amplitude $M_1^{+3/2}$ determined in an energy-independent multipole analysis of $\gamma p \rightarrow N\pi$ reactions. It is indicated that these estimates agree well with the values of M_0 and Γ_0 obtained on the basis of the dispersion relations.

45569 Electromagnetic form factors of the deuteron at large momentum transfers. Kobyshikin, A.P. (Institute of Theoretical Physics, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 252-259(Aug 1978).

A study is made of a model in which the deuteron is regarded as a bound state of two nucleons with a small admixture of a six-quark state. A six-quark wave function which is antisymmetric under interchange of any pair of quarks is constructed in an explicit form. It is found that this six-quark state determines the form factors of the deuteron when the square of the momentum transfer is greater than 1 $(GeV/c)^2$.

45570 Effects of electromagnetic mixing on the mass splitting of the particles in the isomultiplets D (1.87) and D* (2.01). Molchatskii, L.S. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 260-262(Aug 1978).

The Dashen-Frautschi dispersion method is used to derive a relation between the mass differences of the charged and neutral particles in the D(1.87) and D*(2.01) multiplets: M/sub D^+-M/sub D/= $(1+4\mu$/sub π^0/M*/sub D** $(M^*D^{*+}$-M*/sub D^{*0}/. The D^{*+0} particles are described in the calculations by poles of the amplitudes for the scattering processes $D^{0*}\pi^0 \rightarrow D^{0*}\pi^0$ in the channels with the quantum numbers J/sup P/=1^-, I=1/2, and I_3= +-1/2. Models are also considered in which the D^{0*}(1.87) and D^{*0*}(2.01) particles are produced as bound states in the reactions D^{*0*} eta$\rightarrow D^{*0*}$ eta and D^{0*} eta $\rightarrow D^{0*}$ eta, respectively. Numerical estimates of the mass differences are obtained, and it is shown that the dominant contribution to these differences comes from effects of the mixing eta and π^0.

45571 Final-state interaction in the radiative decays of ω and rho meson. Polikarpov, M.I.; Fanchenko, M.S. (Institute of Theoretical and Experimental Physics, state atomic energy commision). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 262-263(Aug 1978).

The experimentally measured ratio of the radiative decay withs of rho and ω mesons does not correspond to the theoretical SU (6) value. An attempt is made to explain this discrepancy in terms of rescattering. It is shown that rescattering in the $\omega\pi$ and rhoπ systems changes the ratio Γ (rho$\rightarrow\pi\gamma$)/Γ ($\omega\rightarrow\pi\gamma$) only by 10% and does not resolve this discrepancy.

45572 Spectral representation for the inelastic form factors of nucleons. Kiselev, A.V.; Petrov, V.A. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 289(Aug 1978).

It is shown that the form factors can be derived by making a standard change of variables in the Jost-Lehmann-Dyson representation.(AIP)

45573 Possibility of measurement of the intrinsic magnetic moment of a free electron. Rubin, P.L. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **48**: No. 2, 185-188(Aug 1978).

We propose a variant of the quasiclassical equations for description of the motion of a nonrelativistic charged particle with spin in a magnetic field, from which it follows, in particular, that it should be possible to carry out a Stern—Gerlach experiment for a free electron.

WEAK INTERACTIONS

45574 Characteristics of possible neutral-heavy-lepton production in muon reactions. Albright, C.H.; Shrock, R.E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **19**: No. 9, 2575-2590(1 May 1979).

We study the production of a neutral heavy lepton by an incident muon via the reaction $\mu^{+-} + N \rightarrow (M\text{-bar})^0 + X$ followed by the decay $(M\text{-bar})^0 \rightarrow \mu^-\mu^+$ xxx . We analyze the experimentally observable characteristics of the resulting dimuon pair and present distributions in final-muon energy, hadron energy, total visible energy, muon transverse momenta, and dimuon invariant-mass and azimuthal-angle correlations. On the basis of this study we formulate a set of cuts and tests which can be used to search for the dimuon signal from the $(M\text{-bar})^0$. The main features of various backgrounds are briefly discussed from the viewpoint of discriminating between them and the $(M\text{-bar})^0$ signal. Our analysis is directly applicable to a current muon experiment being conducted by a Berkeley-Fermilab-Princeton collaboration.

45575 Finite renormalization, flavor mixing, and weak decays. Donoghue, J.F. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **19**: No. 9, 2772-2777(1 May 1979).

We discuss the treatment of flavor-changing self-energies, both for leptons and for quarks in bound states. It is shown that finite self-energy effects can contribute to $\Delta S = 1$ hadronic weak decays.

45576 Leptonic decay of heavy leptons. Tsai, Y.S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 9, 2809-2811(1 May 1979).

The energy-angle distribution of a light charged lepton l from the decay of an arbitrary polarized heavy charged lepton L, $L^- \rightarrow \nu$/sub L/ + nu-bar/sub l/ + l^-, is derived assuming that (1) the mass of ν/sub L/ is not zero and (2) the coupling of WLν/sub L/ is some combination of V and A. The case when ν/sub L/ and nu-bar/sub l/ are identical is also discussed.

45577 Coherent inelastic neutrino scattering by electrons in matter. Varfolomeev, A.A. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 531-534(Oct 1978).

Neutrino scattering on atomic electrons with subsequent photon emission is studied. It is shown that in matter a coherent process is possible which leads to the emission of photons in one direction and increases the low energy inelastic neutrino scattering cross section.

45578 Possible existence of heavy muons. Tarnovskii, A.S. (Kuibyshev Pedagogical Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 582-583(Oct 1978).

The Dirac-Rosen equation is shown to admit the possibility of an excited muon state of mass 4000 GeV and lifetime 10^{-30} sec.

45579 Neutrino processes at high energies and the $\nu\nu$ interaction. Bilen'kii, S.M.; Dadayan, N.A.; Khristova, E.K. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 264-266(Aug 1978).

An upper limit on the effective neutrino-neutrino coupling constant F/sub $\nu\nu$/ deduced from an analysis of data obtained using beams of high-energy neutrinos. It is shown that F/sub $\nu\nu$/ $< 2.8 \times 10^4$G; this limit is an order of magnitude lower than the present upper limit on the constant F/sub $\nu\nu$/.

STRONG INTERACTIONS, GENERAL

45580 Solutions of simple dual bootstrap models satisfying the Lee-Veneziano relation and the smallness of cut discontinuities. Chiu, C.B.; Hossain, M.; Tow, D.M. (Center for Particle Theory, Department of Physics, University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **19**: No. 9, 2778-2791(1 May 1979).

To investigate the t-dependent solutions of simple dual bootstrap models, we discuss two general formulations, one without and one with cut cancellation for the Reggeon-particle amplitude at the planar level. We discuss the possible corresponding production mechanisms. In contrast to Bishari's formulation, both of our models recover the Lee-Veneziano relation, i.e., in the peak approximation the Pomeron intercept is unity. The solutions based on an exponential form for the reduced triple-Reggeon vertex for both models are discussed in detail. We also calculate the cut discontinuities for both of our models and for Bishari's and show that at both the planar and cylinder levels they are small compared with the corresponding pole residues. Precocious asymptotic planarity is also found in our solutions.

45581 Growth of the height of inclusive spectra and average multiplicity in the rapid-pionization model. Potupa, A.S.; Skadorov, V.V.; Fridman, A.S. (Belorussian State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 266-268(Aug 1978).

It is shown that in the previously proposed rapid-pionization model the height of the inclusive spectra increases in proportion to the fourth power of the total collision rapidity (Y < ln($\sqrt{}$s/m/sub p/)), and the average multiplicity increases in proportion to the third power, in good agreement with the experimental ISR—CERN data.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 45594

STRONG INTERACTIONS, BARYON NO.=1

45582 Diffractive production of the A_2 and its implications. Berger, E.L.; Donohue, J.T.; Mennessier, G. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **19**: No. 9, 2595-2606(1 May 1979).

We study diffractive production of the A_2 resonance in the context of a unitarity-corrected Deck production amplitude for $\pi p \rightarrow$ (rhoπ) p. After projecting the D-wave rhoπ production amplitudes from the Deck model with π and rho exchange terms, we include rhoπ final-state rescattering corrections. This corrected Deck amplitude fails to describe the A_2 data in both shape and absolute cross section. To reproduce the data, we require a dominant direct spin-flip coupling of the Pomeron at the πA_2 production vertex, in contradiction with the s-channel helicity and Gribov-Morrison phenomenological rules for diffraction.

45583 Radiative corrections to charge exchange and backward scattering of hadrons. Ginzburg, I.F.; Kotkin, G.L.; Serbo, V.G. (Mathematics Institute, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 526-531(Oct 1978).

For a number of experimental schemes, simple formulas are obtained for the electromagnetic corrections to processes involving charge exchange and backward scattering of hadrons at high energies (in which there is a large change in the motion of the charges). The corrections reach tens of percent in some cases. Allowance for the non-point-like character of the strong interaction is found to be very important.

45584 Hypercharge-exchange reactions in the quasi-eikonal model. Arakelyan, G.G.; Eramyan, S.S.; Nazaryan, A.E. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 534-541(Oct 1978).

The application of the quasi-eikonal model to hypercharge-exchange reactions (HER) $\pi N \rightarrow KY$ and K-barN$\rightarrow \pi$Y, where Y represents a Λ or a Σ hyperon is considered. The SU (3) symmetry is used to relate the K^* and K^{**} pole amplitudes to the rho and A_2 pole amplitudes, obtained earlier from a description of πN and KN scattering. A satisfactory description of the existing experimental data on the considered HER is obtained and experiments necessary for further tests of the model are pointed out.

45585 Diffraction dissociation in the quark model. Tsarev, V.A. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 541-546(Oct 1978).

The process of diffraction dissociation of hadrons at high energies is analyzed on the basis of the quark model. The amplitude for the process is calculated and its qualitative properties are discussed.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 45605, 45606, 45671

45586 Production of fast particles on nuclei in the quark model. Anisovich, V.V.; Shabel'skii, Y.M.; Shekhter, V.M. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 546-554(Oct 1978).

The multiplicity of secondary particles in the fragmentation region in hadron collisions with nuclei is calculated using the model in which the nucleon consists of three quarks separated in space and the π and K mesons are composed of two quarks. For proton beams the yield of secondary protons at $x \sim 2/3$ (and also of π^- and K^+ mesons at $x \sim 1/3$) is determined by the value of the quark-nucleon cross section, which is assumed to be one-third of the inelastic nucleon-nucleon cross section, and by the distribution of matter in the nucleus. The calculated results are in good agreement with the experimental data on the A-dependence of the p, π^-, and K^+ yields in proton-nucleus collisions. This can be interpreted as an argument supporting the three-quark model of the nucleon. The yields of particles on nuclei are predicted for π^-, K-meson, and hyperon beams. The sum rules relating the cross sections for various processes are found.

45587 Scaling violation in the fragmentation region at superhigh energies in the quark model. Anisovich, V.V.; Shekhter, V.M. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 554-557(Oct 1978).

The parton-gluon clouds which form the quarks of a hadron cease to be spatially separated at energies of order 10^6 GeV. This leads to a change in the mechanism of multiparticle production reactions at superhigh energies and to a decrease in the number of fast particles in the fragmentation region.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

45588 Representations of noncompact groups and the two-center problem in quantum mechanics. Truskova, N.F. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 284-287(Aug 1978).

It is shown that the choice of a certain noncanonical basis for the representations of a group that is the direct product rho(3) xrho(2,1) of two groups of motion of three-dimensional spaces, or of the larger groups rho (5,1), rho (4,2), etc., of motions of six-dimensional spaces, leads to the necessity of solving a problem equivalent to the two-center problem in quantum mechanics. The linear algebra of two-center integrals obtained in an earlier paper by the same author is a consequence of the group-theoretical properties of this problem.

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 45567, 45571

45589 SU(4) x U(1) gauge theory. II. CP nonconservation. Deshpande, N.G.; Hwa, R.C.; Mannheim, P.D. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Phys. Rev., D;* **19**: No. 9, 2703-2707(1 May 1979).

We exploit the higher symmetry inherent in an SU(4) x U(1) gauge theory to construct a spontaneously broken theory of CP nonconservation. Higgs multiplets in the adjoint representation of SU(4) contain both even and odd CP fields; thus, requiring the simultaneous nonvanishing of the vacuum expectation values of these fields leads to CP noninvariance of the vacuum. We find that all the CP-nonconserving effects are mediated in our theory by the superheavy gauge bosons of the broken SU(4) x U(1) symmetry. In fact, the very existence of CP violation sets an upper limit on the masses of these bosons. In our model the dominant CP effect lies in the neutral kaon system and is found to arise through a direct ($\Delta S = 2$) K_1-K_2 transition. The model has all the features of a superweak theory, with a neutron electric dipole moment substantially smaller than 10^{-24} e cm.

45590 SU(4) x U(1) gauge theory. III. New approach to Cabibbo mixing. Deshpande, N.G.; Hwa, R.C.; Mannheim, P.D. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Phys. Rev., D;* **19**: No. 9, 2708-2726(1 May 1979).

A new approach to Cabibbo mixing is proposed in the framework of an SU(4) x U(1) gauge theory. Instead of introducing Cabibbo mixing in the quark mass matrix as is usually done in SU(2) x U(1), we take advantage of the existence of the 12 additional gauge bosons and mix the gauge bosons in their mass matrix. It is found that in the most general case there are four mixing angles which are in principle observable. Among them one is the usual Cabibbo angle; another one is like it but is in a different sector. Two angles are associated with CP nonconservation. By demanding that the Higgs potential have the most general form, we show that in our theory Cabibbo mixing and CP and muon-number nonconservation are inevitable. An intimate connection between the Cabibbo angle and the muon-number-nonconserving $\mu \rightarrow e\gamma$ process is obtained. Possible experimental tests of our theory are suggested.

45591 Hierarchy in asymptotic reconstruction of spontaneously broken isotopic symmetry. Ermolaev, B.I. (Yaroslavl State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 558-560(Oct 1978).

The isotopic properties of the effective current-current Lagrangian of the electromagnetic-weak interaction L/sub eff/ between elementary particles are studied at large momentum transfers using the Weinberg-Salam model. It is possible to change over to other models by analogy. It is shown that when the c.m. collision energies of elementary particles exceed 90 GeV the hierarchy can be expected to appear in the asymptotic reconstruction of the isotopic symmetry of L/sub eff/. This hierarchy could be observed, in particular, in experiments on elastic leptonic collisions at high energies.

45592 Effects of symmetry breaking in semileptonic decays of mesons. Khlopov, M.Y. (Institute of Applied Mathematics of the USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 583-584(Oct 1978).

Three-particle decay modes of pseudoscalar mesons are studied in the context of the quark model.

APPLICATIONS TO STRONG INTERACTIONS

REFER ALSO TO CITATION(S) 45598

FIELD THEORY

REFER ALSO TO CITATION(S) 45564, 45567, 45591

45593 Phase transitions in density in gauge theories with spontaneous symmetry breaking. Kavchuk, V.N. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 566-569(Oct 1978).

Phase transitions in the density of fermion charge are investigated in the Weinberg model augmented by a quartet of fractionally charged quarks, and in the palmer model, which represents one of the versions of unifying the electromagnetic, weak, and strong interactions of elementary particles. It is shown that in the framework of these models, for electrically neutral matter, a phase transition in density may occur only if the ratio of the total baryonic charge (B) to the leptonic charge (L) of matter is close to B/L = 1.3. Otherwise, in the limit of extremely large densities the effective masses of the elementary particles increase monotonically as the density of fermionic charge is increased.

45594 Quantum chromodynamics and the problem of the eta/sub c/ meson. Vainshtein, A.I.; Voloshin, M.B.; Zakharov, V.I.; Shifman, M.A. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commision). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 237-242(Aug 1978).

The mass of the eta/sub c/ meson is calculated in the framework of quantum chromodynamics by means of dispersion sum rules. If the spectrum of the 0^- states contains only one strong resonance, like J/psi in the case of the vector states, the mass of eta/sub c/ is found to be equal to 3.0 GeV, and not 2.83 GeV. Thus, X (2.83) cannot be identified with eta/sub c/. It is possible, however, that the spectrum of the 0^- states differs strongly from the spectrum of the 1^- states and there are two mixing mesons with similar masses. Then X (2.83) could be one of these mesons. The coupling of the other meson to the fictitious pseudo-scalar c-quark current c-bar γ_5c is much the greater, and this meson is the "true" eta/sub c/ meson. In the case of two mixing states, the eta/sub c/ mass is equal to 3.0-3.2 GeV. The existence of such states is in no way excluded experimentally.

45595 Nambu-Goldstone realizations of dynamical groups, and nonlinear equations. Konopel'chenko, B.G. (Nuclear Physics Institute, Siberian Division USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 268-270(Aug 1978).

It is shown that field theories describable by fully integrable equations (in particular, the theory of any free field) are theories of the Nambu-Goldstone type.

45596 Bound on fermion mass in gauge theories of the weak and electromagnetic interactions. Krasnikov, N.V. (Institute of Nuclear Research, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 279-280(Aug 1978).

It is shown that in gauge models of the weak and electromagnetic interactions the fermion (quark, lepton) mass in order of magnitude cannot exceed the mass of the heaviest boson. In an SU (2) xU (1) gauge model of the weak and electromagnetic interactions with the isodoublet of scalar fields, the fermion mass cannot be greater than 750 GeV.

45597 Density matrix in quantum electrodynamics and the Hawking effect. Gitman, D.M.; Frolov, V.P. (P. N. Lebedev Physical Institute, USSR Academy of Sciences, Moscow). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 281-283(Aug 1978).

An expression has been obtained for the density matrix describing particles of one kind (electrons or positrons) created by an external electromagnetic field from the vacuum. The explicit form of this matrix has been derived for the case of a static homogeneous electric field. Arguments are presented in favor of the assertion that the character of the density matrix describing particles created in the gravitational field of a black hole is related to the equivalence principle.

SCATTERING THEORY

REFER ALSO TO CITATION(S) 45672

45598 Plane waves on the impact parameter group. Vall, A.N. (Siberian Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 561-564(Oct 1978).

The impact-parameter plane is constructed as a space which is conjugate (in the sense of the Fourier transform) to the plane of the transverse momentum of two spinless particles in the c.m.s. The role of the kernel of the transformation from one space to the other is played by "impact-parameter plane waves" that realize the fundamental series of unitary representations of the group SO(2, 1) in momentum space. The problem of expanding the scattering amplitude in terms of these plane waves is discussed.

45599 Kinematically independent representation of relativistic three-particle experimental data and their partial-wave analysis. Klepikov, N.P.; Garask'ko, G.I. (Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 271-279(Aug 1978).

Formulas are presented for the conversion of the triads of momenta, obtained in a kinematically complete observation of reactions in which three relativistic particles are produced, into points of the maximally kinematically independent phase space, and vice versa. Under this conversion, the phase space becomes a five-dimensional sphere with a constant phase density, one of the sections of which is a circular Dalitz plot. This transformation makes possible a partial-wave analysis of three-particle reactions in which all particles are on a par.

45600 High-energy asymptotic behavior of the potential scattering amplitude. Skriganov, M.M. (Leningrad Branch, V. A. Steklov

Institute of Mathematics of the Academy of Sciences of the USSR). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 7, 472-474(Jul 1978).

Equations are derived for the coefficients of the asymptotic solution. (AIP)

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

45601 (LA—7843-PR) **Applied nuclear data research and development. Progress report, January 1—March 31, 1979.** Baxman, C.I.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 38p. Dep. NTIS, PC A03/MF A01.

This report describes the activities of the Los Alamos Nuclear Data Group in the following areas: theory and evaluation of nuclear cross sections; nuclear cross section processing; and fission products and actinides: yields, yield theory, decay data, depletion, and buildup. Several calculation procedures are discussed, and the results are compared with experimental data already included in the TIC data base. One can expect completed work to be reported in the usual channels. 9 figures, 8 tables. (RWR)

45602 (UCRL—50400(Vol.1)(Pt.B)) **Program ECSX4 (version 78-1): conversion of experimentally measured cross-section data from the four-center-exchange (X-4) format to the Livermore ECSIL format.** Cullen, D.E.; Perkins, S.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1978. Contract W-7405-ENG-48. 132p. Dep. NTIS, PC A07/MF A01.

A computer code called ECSX4 converts experimentally measured cross-section data from the four-center-exchange (X-4) format to the Livermore Experimental Cross-Section Information Library (ECSIL) format. The major advantage of this program is that it converts the variable format and dimensioned data of the X-4 format to the fixed-field format and consistent set of units of the ECSIL format. This consistency greatly simplifies the subsequent use of the data for cross-section evaluations. 2 figures, 3 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

45603 **Possibility of a simple scheme of estimating the binding energies of s-shell nuclei.** Bursak, A.V.; Verzhbitskii, V.V.; Gorbatov, A.M.; Krylov, Y.P.; Solovei, A.B. (Kalinin State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 457-458(Oct 1978).

A simple and reliable scheme is proposed for estimating the binding energies of s-shell nuclei, with a realistic soft-core nucleon-nucleon potential.

NUCLEAR REACTIONS AND SCATTERING

45604 (SLAC-PUB—2334) **Elastic electron scattering at large momentum transfer.** Arnold, R.G. (Stanford Linear Accelerator Center, CA (USA)). May 1979. Contract DE-AC03-76SF00515. 6p. (CONF-790610—2). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

A review is given of elastic electron scattering at large momentum transfer ($Q^2 > 20$ fm^{-2}) from nuclei with A $\geqq$ 4. Recent experimental results are reviewed and the current problems in interpretation of these results are pointed out. Some questions for future experiments are posed, and a preview of possible future measurements is presented. 28 references.

45605 **Decrease of charge form factor of the deuteron at large q^2 in the dispersion-relation approach.** Troitskii, V.E. (Institute of Nuclear Physics, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 462-464(Oct 1978).

It is shown that allowance for the interaction in the initial and final states in the dispersion-relation approach describes the rapid decrease of the deuteron charge form factor at large q^2. The behavior of the deuteron form factor at large q^2 is investigated as a function of the high-energy behavior of the phase shift.

45606 **Two- and three-nucleon problems in the boundary condition model.** Petrov, N.M.; Simenog, I.V. (Institute of Theoretical Physics, Academy of Sciences of the Ukrainian SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 193-196(Aug 1978).

The potential scattering problem is studied using the two-particle boundary-condition model, which is equivalent to a superposition of δ potentials and permits a simple model of short-range interactions to be constructed. The model is related to the variable-phase method. The low-energy three-nucleon parameters are calculated for the case of a δ potential. The results are compared with experiment and with other calculations.

45607 **Approximate four-particle equations for π-nuclear scattering.** Belyaev, V.B.; Wrzecionko, J. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 198-203(Aug 1978).

The multidimensional separable expansion method is used to find different variants of integral equations for the elastic and inelastic scattering amplitudes in the four-body system (π (K)+3N). The t matrices describing the scattering of particles on nuclear subsystems with fixed centers are used as an input in these equations. The elastic scattering turns out to be described by one-dimensional equations of the Lippmann-Schwinger type and the equations for inelastic scattering are of the Faddeev type.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 45556

45608 **^{4}He (γ,p) -to- (γ,n) cross-section ratio.** Phillips, T.W.; Berman, B.L.; Faul, D.D.; Calarco, J.R.; Hall, J.R. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **19**: No. 6, 2091-2098(Jun 1979).

We have measured the cross-section ratio σ (γ,^{3}H)/σ (γ,^{3}He) for ^{4}He from 31 to 51 MeV with an incident bremsstrahlung beam and a collimated solid-state telescope at 90° laboratory angle. The results obtained from these data for the total cross-section ratio are consistent with unity for most of the energy range covered, but deviate from this value in the energy region near 44 MeV.

45609 **Study of quasielastic scattering of electrons in the reaction ^{3}He(e,e').** Kuplennikov, E.L.; Gol'dshtein, V.A.; Shostak, V.B.; Pegushin, E.V. (Khar'kov Physico-technical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 142-143(Aug 1978).

The absolute differential cross section for quasielastic scattering of electrons in the reaction ^{3}He(e,e') has been measured as a function of the scattered electron energy in the range of scattering angles 15—29° for an incident electron energy 1211 MeV.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

45610 **Nuclear charge dependent interactions in the 1p shell.** Lawson, R.D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **19**: No. 6, 2359-2368(Jun 1979).

A shell model analysis of the isobaric mass multiplets in the 1p shell shows that the isotensor charge dependent contribution (the coefficient of T/sub z/^{2} in the multiplet relationship) is, in all cases save one, underestimated when only electromagnetic interactions [including $(v/c)^2$ corrections, vacuum polarization, the effect of short range correlations, and finite neutron and proton size] are considered. Furthermore, the discrepancy is nearly twice as large for the seniority zero levels as for the higher seniority states, indicative of the omission of a short range charge dependent interaction. Since the free nucleon-nucleon scattering data indicate that the (np) interaction is ~2% more attractive than the (nn), the effect of including such a charge dependent nuclear interaction on this coefficient is examined. When a Yukawa potential with range given by the π-meson Compton wavelength is taken for this potential it is found that theory and experiment can be brought into much better agreement.

NUCLEAR REACTIONS AND SCATTERING

45611 **d + ^{6}Li reactions at low energy.** Elwyn, A.J.; Monahan, J.E. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **19**: No. 6, 2114-2120(Jun 1979).

Recent differential and total cross-section data relating to the ^{6}Li(d,α)^{4}He, ^{6}Li(d,p)^{7}Li, and ^{6}Li(d,n)^{7}Be reactions at deuteron energies between 0.1 and 1.0 MeV are analyzed in terms of the Wigner-Eisenbud formalism with the R-matrix elements assumed constant, i.e., independent of the energy of the incident deuteron. For the (d,p) and (d,n) reactions the possibility of an additional coherent direct-reaction contribution is also considered. The data are reasonably well reproduced by these calculations. The results thus

give an indication of the magnitude of the direct contributions to these reactions. The results also show that the observation of a resonancelike structure in, e.g., the ^{6}Li(d,α)^{4}He reaction, does not necessarily imply a corresponding state in ^{8}Be.

45612 Neutron scattering cross sections of carbon below 2 MeV recommended from R-matrix fits to Data. Fu, C.Y.; Perey, F.G. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *At. Data Nucl. Data Tables;* **22**: No. 3, 249-267(Sep 1978).

Cross-section and polarization data for neutron interaction with carbon below the inelastic threshold (4.81 MeV) were evaluated and analyzed by R-matrix theory. Six sets of total cross-section data below 2 Mev were partially smoothed and least-square fitted with non-diagonal weighting to obtain averages with estimated uncertainties for use in the R-matrix search program. The resulting differential scattering cross sections below 2 MeV are recommended as standards. The good quality of the fits well above 2 MeV and a high-precision (0.1%) thermal value enhance the confidence in the recommended values below 2 MeV.

45613 Mechanism of the reaction ^{12}C(π^+,π^+ ^{4}He)^{8}Be at 112 MeV. Gismatullin, Y.R.; Lantsev, I.A. (Leningrad Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 156-158(Aug 1978).

The pole approximation has been used to carry out a theoretical analysis of inelastic scattering of 112-MeV π^+ mesons by carbon with emission of an α particle and formation of the intermediate nucleus ^{8}Be in the ground state and first excited state. We have calculated the momentum and angular distributions of ^{8}Be nuclei, the energy and angular distributions of α particles, and the differential cross section for scattering of π^+ mesons. The experimental data are satisfactorily described in terms of direct knockout of α particles and ^{8}Be nuclei with allowance for the intranuclear motion, binding energy, and effective potential barrier. It is shown that in the region of low α-particle momenta (less than 200 MeV/c), knockout of ^{8}Be nuclei is dominant. We have estimated the contribution to the reaction studied from the statistical decay of excited ^{12}C nuclei, which amounted to about 30%.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 45614, 45621

NUCLEAR REACTIONS AND SCATTERING

45614 ^{12}C(^{7}Li, t)^{16}O and stellar helium fusion. Becchetti, F.D.; Flynn, E.R.; Hanson, D.L.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Phys., A;* **305**: No. 1, 293-312(31 Jul 1978).

The reaction ^{12}C(^{7}Li, t)^{16}O has been studied at E(^{7}Li) = 34 MeV with the LASL tandem accelerator and QDDD magnetic spectrometer. Angular distributions to levels with E/sub x/ < 11 MeV have been obtained from 0° to 90°, including 0°. The results have been analyzed with finite-range distorted-wave Born approximation theory. The α-particle spectroscopic factors and reduced widths obtained are compared with those calculated with group theory (SU(3)) and other models. The analysis of data for the 7.1 and 9.6 MeV J/sub π/ = 1$^-$ levels, which are of great importance in steller helium burning, yields a ratio, R, of dimensionless reduced α-widths theta^2/sub α/(7.1 MeV)/theta^2/sub α/(9.6 MeV) = 0.35 +- 0.13. The observed line width of the 9.6 MeV level (GAMMA/sub c.m./ = 390 +- 60 keV) is less than the accepted value (GAMMA/sub c.m./ = 510 +- 60 KeV) and implies theta^2/sub α/ 9.6 MeV) approximately 0.6. These results as well as data for the 6.92 MeV J/sup π/ = 2$^+$ and 10.35 MeV J/sup π/ = 4$^+$ α-cluster states indicate 0.09 < theta^2/sub α/(7.1 MeV) < 0.33 with a mean value theta^2/sub α/ (17.1 MeV) = 0.14 +- 0.04. The implication for stellar helium burning is discussed.

45615 Fusion and peripheral reactions of ^{12}C + ^{14}N at energies up to 13 MeV/A. Gomez del Campo, J.; Stokstad, R.G.; Biggerstaff, J.A.; Dayras, R.A.; Snell, A.H.; Stelson, P.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **19**: No. 6, 2170-2185(Jun 1979).

Angular and energy distributions have been measured for reaction products of the ^{14}N + ^{12}C system at nine bombarding energies in the energy range E$_{^{14}N}$ = 34.1 to 178.1 MeV. The fusion and direct reaction components for products from Li to Al have been determined. The experimental fusion cross sections and deduced critical angular momenta are discussed in terms of entrance channel models for compound nucleus formation and the rotating liquid drop model. Hauser-Feshbach calculations of the Z distributions, energies, and angular distributions of evaporation residues are presented and compared to the data. The direct reaction yield has been analyzed with a diffraction model and is also compared with time-dependent Hartree-Fock calculations. The experimental total reaction cross section is in good agreement with optical model calculations.

45616 Estimate of the effective mass of an intranuclear nucleon from experiments on inelastic scattering of electrons. Dementii, S.V.; Ogurtsov, V.I.; Afanas'ev, N.G. (Khar'kov Physicotechnical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 443-445(Oct 1978).

Measurements were made of quasielastic scattering of electrons in the (e, e') reaction by the nuclei ^{9}Be, ^{12}C, ^{14}N, ^{16}O, and ^{27}Al. An experimental estimate is obtained of the effective mass of an intranuclear nucleon. At excitation energies up to 80 MeV, a ratio M*/M=0.6 is obtained, corresponding to a linear potential V (E) =V$_0$+0.4E and in good agreement with the data on proton scattering by nuclei [C. M. and F. G. Perey, Atomic Data and Nuclear Tables 13, 294 (1974)]. At excitation energies above 120 MeV the nucleon effective mass turned out to be close to that of the free nucleon, M*/M=0.9.

45617 Secondary particles in inelastic interactions of nuclei with nuclei at energies 0.1—1 GeV/nucleon. Bakaev, V.A.; Bogdanov, S.D.; Dudkin, V.E.; Ostroumov, V.I.; Peregudova, V.V.; P'yanov, I.I.; Stepnov, V.D. (Institute of Medical and Biological Problems, USSR Ministry of Health). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 448-452(Oct 1978).

The validity of use of the cascade-disintegration model for description of inelastic nucleus-nucleus interactions at high energies is justified. Comparison of theoretical values with experimental data and also with results of studies by others permits the conclusion that it is possible to calculate differential cross sections for the yield of secondary particles in inelastic nucleus-nucleus collisions. The experimental data satisfactorily confirm and supplement calculated values.

45618 Some singularities of the interaction of nuclei with nuclei at high energies. Vernov, S.N.; Grigorov, N.L.; Chudakov, A.E. (Nuclear Physics Institute, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 524-525(Oct 1978).

The multiplicity distribution of the particles produced in interactions of high-energy cosmic-ray particles is considered. It is shown that the multiplicity variance does not agree with the hypothesis that the nucleons of the colliding particles interact independently, and that the multiplicity distribution in nucleus-nucleus interactions is similar to the multiplicity distribution in hadron-hadron interactions.

45619 α-cluster states in ^{17}O observed in the reaction ^{13}C(^{6}Li, d)^{17}O(α)^{13}C. Artemov, K.P.; Gol'dberg, V.Z.; Petrov, I.P.; Rudakov, V.P.; Serikov, I.N.; Timofeev, V.A.; Wolski, R.; Szmider, J. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 145-150(Aug 1978).

The angular correlation functions betwen deuterons and α particles from the reaction ^{13}C(^{6}Li, d)^{17}O(α)^{13}C have been measured for three energies of incident ^{6}Li ions: 26, 29, and 34 MeV. A series of states with large reduced α-particle widths is found. For these states we have determined the orbital angular momenta of α decay and consequently the parities of the states. An analysis carried out shows that in the odd nucleus ^{17}O groups of α-cluster states are distinguished whose properties (location and reduced widths) are close to those of the similar states observed in the 4N nuclei ^{16}O and ^{20}Ne.

45620 Study of the reaction μ^-^{6}Li→^{3}H^{3}Hν in emulsion loaded with ^{6}Li. Batusov, Y.A.; Bunyatov, S.A.; Vizireva, L.D.; Galstyan, D.A.; Gulkanyan, G.A.; Kostanashvili, N.I.; Cueer, P.; Massue, J.P.; Mirsalikhova, F.K.; Sidorov, V.M.; Chernev, K.M.; Eramzhyan, R.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 233-236(Aug 1978).

Nuclear emulsion loaded with ^{6}Li has been used to study the reaction μ^- ^{6}Li→^{3}H^{3}Hν.It is found that the relative probability of this reaction is (9.7 +- 3.1) x 10^{-2}. The energy and angular distributions of secondary particles from this reaction agree qualitatively with estimates made on the assumption that capture of μ^- mesons by ^{6}Li nuclei in this reaction occurs in the few-nucleon cluster [^{3}He].

45621 ^{13}C(^{6}Li, d)^{16}O and ^{16}O(^{6}Li, d)^{20}Ne at E(^{6}Li) = 42 MeV. Becchetti, F.D.; Jaenecke, J. (Michigan Univ., Ann Arbor (USA). Dept. of Physics); Thorn, C.E. (Brookhaven National Lab., Upton, NY (USA)). *Nucl. Phys., A;* **305**: No. 1, 313-332(31 Jul 1978).

Spectra up to 25 MeV excitation in ^{16}O have been obtained from ^{13}C(^{6}Li, d) at 42 MeV bombarding energy. Angular distributions have been measured for ten states, including two J/sup π/ = 1$^-$ states of astrophysical interest, and appear to be mostly direct α-transfer. In addition, data for ^{16}O(^{6}Li, d)^{20}Ne(g, s) and ^{20}Ne*(2$^+$) have been obtained. Excitation energies and widths have been extracted for states in ^{16}O, including several states at E/sub x/ > 15

MeV. Alpha spectroscopic factors, S/sub α/ and reduced α-widths, γ²/subα/ and theta²/sub α/ have been deduced for levels in ^{18}O and ^{20}Ne and compared with theoretical predictions. The J/sup π/ = 1⁻ levels in ^{18}O at 7.12 and 9.6 MeV excitation appear to have comparable S/sub α/ and γ²/sub α/ values, viz, γ²/sub schemical bond/ (7.12 MeV)/γ²/sub α/ (9.6 MeV) = 0.6(+1.7-0.3). Both states have apparent S/sub α/ and theta²/sub schemical bond/ values smaller than that for the J/sup π/ = 2⁺ 'α-cluster' state at 6.9 MeV however. Furthermore, the observed line shape for the Jsup(π) = 1⁻, 9.6 MeV level indicates GAMMA/sub c.m./ = 400 +- 50 keV, which is substantially less than the accepted width for this level (GAMMA/sub c.m./ = 510 +- 60 keV). The possible implications of these results for stellar helium burning calculations are discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 45651, 45656

45622 Study of three-particle nuclear molecular states. Calculation for the ^{28}Si nucleus. Wiebicke, H.; Zhukov, M.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 475-479(Oct 1978).

A calculation of the highly excited states of the ^{28}Si nucleus is given on the assumption of a three-particle (^{12}C—α—^{12}C) structure of such states. With allowance for the symmetry properties of the system we have calculated the wave functions, energy eigen-values, and intrinsic configurations of the states.

MOMENTS AND SPIN

45623 Anomalous dependence of the effective asphericity of the inertia ellipsoid in light nuclei upon the total angular momentum. Filippov, G.F.; Steshenko, A.I.; Pavlenko, O.P. (Institute for Theoretical Physics, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 458-462(Oct 1978).

We investigate the dependence of the effective parameters of the characteristic nuclear shape on the angular momentum of rotational excitations, the intrinsic wave functions of which belong to the [f+λ, f, f] representation of the group SO(A-1). Specific calculations are performed in the examples of ^{8}Be and ^{20}Ne.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

45624 Anomaly in elastic scattering of protons by ^{31}P at the threshold energy of the (p,n) reaction. Cenja, M.; Duma, M.; Hategan, C.; Tanase, M. (Central Institute of Physics; Institute of Physics and Nuclear Engineering, Bucharest, Romania). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 290-291(Aug 1978).

Elastic backscattering excitation functions were measured at scattering angles 160, 150, 140, 130, and 110°. At the (pgn) threshold energy, 6.425 MeV, an anomaly is observed similar to that previously found for ^{27}Al.(AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 45629

ENERGY LEVELS AND TRANSITIONS

45625 L = 1 single-proton pickup reactions on ^{40}Ca. Bond, P.D.; LeVine, M.J.; Pisano, D.J.; Thorn, C.E.; Lee, L.L. Jr. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **19**: No. 6, 2160-2166(Jun 1979).

In an attempt to determine the cause of the out-of-phase behavior of the angular distributions for the (^{13}C,^{14}N) L = 1 transfer reactions on Ca isotopes measured at 68 MeV bombarding energy, several projectiles have been used which change specific parameters in the experiment. In contrast to the 68 MeV ^{40}Ca(^{13}C,^{14}N) data, the results for 50 MeV (^{13}C,^{14}N), 70 MeV (^{14}N,^{15}O), and 70 MeV (^{15}N,^{16}O) reactions to the s/sub 1/2/ state in ^{39}K are in excellent agreement with distorted-wave Born-approximation calculations. A phasing problem between data and theory for the d/sub 3/2/ state in ^{39}K is present for two of these reactions, but is not as severe as with the earlier (^{13}C,^{14}N) measurement.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 45561

45626 (ANL/NDM—47) Scattering of MeV neutrons from elemental iron. Smith, A.; Guenther, P. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 43p. Dep. NTIS, PC A03/MF A01.

Neutron elastic- and inelastic-scattering cross sections of elemental iron are measured from 1.5 to 4.0 MeV with incident-neutron resolutions of < or approx. = to 50 keV and at incident-neutron energy intervals of < or approx. = to 50 keV. Cross sections for the excitation of observed levels at 0.853, 1.389, 2.097, 2.579, 2.677, 2.974 and 3.152 MeV are determined. The observed elastic- and inelastic-scattering angular distributions fluctuate strongly with incident energy. The experimental results are averaged over broad energy intervals and interpreted in terms of spherical optical-statistical and coupled-channels models including consideration of direct-vibrational excitations. The importance of a comprehensive data base in such energy-averaged interpretations and of the direct-vibrational excitations is stressed. The present measured and calculated results, combined with those reported in the literature, are used to formulate an evaluated scattered-neutron data file in the ENDF format extending from 1.0 to 4.0 MeV. 41 references.

45627 Charged-particle emission in reactions of 15-MeV neutrons with isotopes of chromium, iron, nickel, and copper. Grimes, S.M.; Haight, R.C.; Alvar, K.R.; Barschall, H.H.; Borchers, R.R. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., C;* **19**: No. 6, 2127-2137(Jun 1979).

Cross sections have been measured for the emission of protons, deuterons, and alpha particles for 15-MeV neutrons on /sup 54,56/Fe, /sup 58,60/Ni, /sup 50,52/Cr, and /sup 63,65/Cu, as well as on natural iron, nickel, and chromium. A quadrupole spectrometer served to detect particles with energies as low as 1 MeV. For some of the targets, a substantial fraction of the charged-particle spectrum is at energies below the Coulomb barrier. Cross sections and spectra are compared with statistical and pre-equilibrium model predictions.

45628 Interactions of 400-GeV/c protons with emulsion nuclei. Two-particle correlations between produced particles. Alma-Ata—Gatchina—Moscow—Tashkent Collaboration. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 507-511(Oct 1978).

The two-particle correlations between the pseudorapidities and azimuthal angles of the secondary shower particles from proton-nucleus interactions at 400 GeV is studied. Considerable attention is given to the inclusion of pseudo- and kinematical correlations. The results are compared to proton-nucleon interactions at the same energy and to hadron-nucleus events at energies < or =200 GeV. The data are qualtitatively compared to the predictions of a number of models of multiparticle production in hadron-nucleus interactions.

45629 Charge density distribution in the nuclei /sup 50,52,53,54/Cr and /sup 54,56/Fe. Shevchenko, N.G.; Polishchuk, V.N.; Kasatkin, Y.A.; Khomich, A.A.; Buki, A.Y.; Mazan'ko, B.V.; Shula, G.V. (Khar'kov Physico-technical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 139-142(Aug 1978).

The charge density distribution is investigated in the nuclei of the isotopes /sup 50,52,53,54/Cr and /sup 54,56/Fe by the method of elastic scattering of electrons with energy 226.7 MeV. The changes in the charge density distribution on adding nucleons are determined. The experimental results are compared with calculations by the Hartree-Fock method on the basis of a Skyrme nucleon-nucleon interaction potential.

45630 Low-energy particles in stars produced by ^{12}C nuclei with momentum 50 GeV/c. Kosice—Leningrad Collaboration. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 219-221(Aug 1978).

Singly and doubly charged particles with ranges less than 3 mm, produced in interactions of carbon nuclei having a momentum 4.2 GeV/c per nucleon with emulsion nuclei are investigated. The results of the experiment are compared with deuteron-nucleus and proton-nucleus collisions at similar velocities of the initiating particle. The hardening of the energy spectra and the appreciable decrease of the effective Coulomb barrier with increasing mass of the incident particle are discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

45631 Masses of the stable isotopes of Br, Kr, and Rb. Demirkhanov, R.A.; Dorokhov, V.V.; Dzkuya, M.I.; Dorokhova, G.A. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 137-138(Aug 1978).

The mass-spectrographic doublet method has been used to measure the masses of all stable isotopes of bromine, krypton, and rubidium. Organic compounds of various compositions were used as standards. Extensive use was made of internal self-consistency checks. The mass of each isotope was measured with six to ten independent doublets of different composition and origin. In all elements isotopic doublets were measured. A total of 85 principal doublets were measured and by their means the masses of ten isotopes of Br, Kr, and Rb were determined. The relative accuracy of the measurements is $\Delta M/M \approx 1 \times 10^{-7}$.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 45632

NUCLEAR REACTIONS AND SCATTERING

45632 (ANL/NDM—44) Interaction of fast neutrons with ^{60}Ni. Smith, A.; Guenther, P.; Smith, D.; Whalen, J. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 39p. Dep. NTIS, PC A03/MF A01.

Neutron total cross sections of ^{60}Ni are measured with broad resolutions from ~ 0.5 to 5.0 MeV at intervals of ~ < 50 KeV. Differential elastic-neutron-scattering cross sections are measured from 1.5 to 4.0 MeV at intervals of ~ < 50 keV over the scattered-neutron angular ramge of ~ 20 to 160 deg. Differential cross sections for the inelastic-neutron excitation states at 1.342 +- 0.013, 2.168 +- 0.010, 2.304 +- 0.026, 2.509 +- 0.022, 2.636 +- 0.019 and 3.164 +- 0.041 MeV are measured. The experimental results are interpreted in terms of optical-statistical and coupled-channels models including consideration of compound-nucleus fluctuations and direct-vibrational processes. 32 references.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

45633 (COO—3069-674) Leptonic probes of nuclear densities. Negele, J.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). Jan 1979. Contract EY-76-C-02-3069. 17p. (CONF-790126—4; OSP—77906). Dep. NTIS, PC A02/MF A01.

From LAMPF workshop on Pion Single Charge Exchange; Los Alamos, NM, USA (22 Jan 1979).

A critical review is presented of present knowledge of nucleon density distributions from leptonic probes and its implications for medium energy physics.

45634 Study of giant resonances in nuclei with the aid of proton and electron scattering. Akulinichev, S.V.; Afanas'ev, G.N.; Vdovin, A.I.; Stoyanov, C.; Shilov, V.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 453-456(Oct 1978).

The electroexcitation of giant-resonance levels is investigated within the framework of a semimicroscopic model with ^{90}Zr as an example. The calculations are made both in the one-phonon approximation and with level fragmentation taken into account. In either case the calculation results stay within the limits of the experimental errors. The possibility of factoring cross sections for electron and proton scattering on the giant-resonance levels is considered. This possibility stems from the fact that the transition densities of the strongest levels of the giant resonance are approximately identical in shape in the averaging interval. In the case of protons there are additional arguments due to the strong absorption in the interior of the nucleus.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 45662

45635 Time-dependent Hartree-Fock-Bogoliubov calculations of heavy-element fusion and fission phenomena. Cusson, R.Y.; Meldner, H.W. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev. Lett.;* **42**: No. 11, 694-696(12 Mar 1979).

Time-dependent Hartree—Fock—Bogoliubov calculations in three dimensions are reported for the fusion of two ^{110}Pd isotopes and subsequent fission of the compound nucleus ^{220}U. Constant-strength pairing, and simplified Skyrme plus Yukama and Coulomb interactions were included. A new result is the appearance of (non-axial) surface oscillations in the compound or fissioning systems.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 45639

45636 Nuclear data sheets for A=136. Peker, L.K. (National Nuclear Data Center Brookhaven National Laboratory Upton, New York 11973, USA). *Nucl. Data Sheets;* **26**: No. 3, 473-524(Mar 1979).

The experimental nuclear structure data available through August 1978 have been reviewed. A summary of information obtained in various reaction and decay experiments is presented, together with adopted level schemes.

45637 Effect of pair interactions on the values of δ = (E2/M1)/sup 1/2/ in $2^+_2 \rightarrow 2^+_1$ transitions of tin isotopes. Demidov, A.M.; Govor, L.I.; Zhuravlev, O.K.; Komkov, M.M.; Kurkin, V.A.; Shukalov, I.B. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 445-447(Oct 1978).

The values of δ= (E2/M1)/sup 1/2/ for $2^+_2 \rightarrow 2^+_1$ transitions in /sup 116,118,120,122,124/Sn are determined from the results of the measurements of the angular distributions of the gamma quanta in the reaction (n, n'γ). An analysis of the behavior of 1/δ when the number of neutrons is varied has shown that the sign of this quantity is governed by the sign of the magnetic moment of the neutron in the j-state in which the last neutron pair can be with sufficiently high probability and can at the same time be most weakly bound. The weak bond of last neutron pair in the tin isotopes occurs at the start of the filling of the 1h/sub 11/2/ and 2d/sub 3/2/ shells.

NUCLEAR REACTIONS AND SCATTERING

45638 (DOE/ER/71001—7) Total pion cross section measurements. Annual progress report, January 1, 1978—December 31, 1978. Jakobson, M.J.; Jeppesen, R.H. (Montana Univ., Missoula (USA)). 21 Mar 1979. Contract EY-76-S-06-2232-001. 9p. (RLO—2232-T1-7). Dep. NTIS, PC A02/MF A01.

The pion-nucleus total cross section runs were completed. The principal effort for the past year has been devoted to data analysis. Some preliminary results for the heavy elements have been submitted in a contributed paper. A paper on the Coulomb effects in the Klein—Gordon equation for pions has also been submitted. π +- data to be published include targets and energies for ^{4}He, 23 - 90 MeV; ^{12}C, ^{13}C, 23 → 240 MeV; ^{6}Li, ^{7}Li, ^{9}Be, ^{10}B, ^{11}B, 43 → 215 MeV; ^{16}O, ^{18}O, ^{40}Ca, ^{44}Ca, ^{48}Ca, 43 → 240 MeV; ^{45}Sc, ^{51}V, Al, Cu, Sn, Ho, Pb, 60 → 215 MeV.

45639 Direct neutron decay of analog resonances in ^{94}Mo. Guzhovskii, B.Y. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 490-495(Oct 1978).

A method taking into account the contribution of direct neutron decay of analog resonances to the partial cross sections of (p,n) reactions has been used to analyze the published experimental data for the reaction ^{93}Nb (p,n) ^{93}Mo and to determine the partial widths of direct neutron decay of analog resonances with J/sup π/ =3^+, 4^+, 5^+, 6^+, and 7^+ to levels of ^{93}Mo with E/sub x/< or =2.8 MeV. It is observed that the maximum values of the reduced widths correspond to transitions to levels of positive parity which appear comparatively weakly in direct reactions.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

45640 Collective and two-quasiparticle states in ^{158}Gd observed through study of radiative neutron capture in ^{157}Gd. Greenwood, R.C.; Reich, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)); Baader, H.A.; Koch, H.R.; Breitig, D.; Schult, O.W.B.; Mampe, W.; von Egidy, T.; Schreckenbach, K. (Technische Univ. Muenchen (Germany, F.R.)); Fogelberg, B. *Nucl. Phys., A;* **304**: No. 2, 327-428(24 Jul 1978).

The level structure of ^{158}Gd has been studied using the prompt γ-rays and conversion electrons emitted following neutron capture in ^{157}Gd. From the data, a neutron separation energy of 7937.1+-0.5 keV has been determined for ^{158}Gd. A level scheme containing 59 excited states with energies <2.25 MeV, for which de-excitation modes have been identified, is proposed for ^{158}Gd. Many

of these states have been grouped into rotational bands. A total of thirteen excited rotational bands with band-head energies below 2.0 MeV are contained in the level scheme. An analysis of (d, p) reaction data is presented which permits definite two-quasiparticle configuration assignments to be made to most of these latter bands. Evidence is presented which suggests strong mixing of some two-neutron and two-proton bands. A phenomenological four-band mixing analysis is made of the energy and E2 transition-probability data for the ground-state band and the three lowest-lying excited collective positive-parity bands. Good agreement with experiment is obtained. A Coriolis-mixing analysis of the octupole bands has been carried out and good agreement with the data on level energies and E1 transition probabilities to the ground-state band has been achieved. Values of Z, the ratio of the E1 transition matrix element with $\Delta K = 1$ to that with $\Delta K = 0$, involving the octupole bands and the first four 0^+ bands are derived. For three of these 0^+ bands, absolute values of these matrix elements are deduced. An interesting alternation in the sign of Z is observed for these four 0^+ bands.

NUCLEAR REACTIONS AND SCATTERING

45641 Anomalous α-decay rate of ^{192}Pb. Toth, K.S.; Ijaz, M.A.; Bingham, C.R.; Riedinger, L.L.; Carter, H.K.; Sousa, D.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **19**: No. 6, 2399-2402(Jun 1979).

An anomalous behavior has been reported by Hansen et al. for the α-decay rates of neutron-deficient lead isotopes. In particular, the α reduced width of ^{192}Pb appears to be large. Their α-branching ratios, however, are based on (electron capture + β^+) decay strengths deduced from K x-ray intensities. More precise values can be obtained if the (electron capture + β^+) decay scheme is known. To this end we investigated the decay properties of ^{192}Pb with the use of an on-line isotope separator. The nuclide was produced in the ^{180}W(^{16}O,4n) reaction. Singles and coincidence γ-ray data as well as singles conversion-electron spectra were accumulated. Also, singles γ-ray, x-ray, and α-particle spectra were taken with the three detectors placed in calibrated geometries. The ^{192}Pb α reduced width was found to be lower by a factor of 2 from that of Hansen et al. but nevertheless much larger than one would expect from neighboring α-emitting nuclides.

45642 Energy distributions of neutrons in the reaction Ta(p,xn) at a proton energy 23 MeV. Svirin, M.I.; Kazanskii, S.A.; Matusevich, E.S.; Prokhorov, S.S. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 144(Aug 1978).

Neutron energy distributions have been measured in the reaction Ta(p,xn) in the neutron energy range 0.07—11.5 MeV by means of recoil-proton proportional counters and a scintillation spectrometer employing a stilbene crystal.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

45643 Possibilities of synthesis of transmendelevium superheavy elements with Pb targets. Gupta, R.K.; Pirvulescu, C.; Sandulescu, A.; Greiner, W. *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 160-162(Aug 1978).

Fragmentation theory is used as the basis for discussion of the use of beams of ^{48}Ca, ^{50}Ti, and ^{54}Cr ions for synthesis of the light isotopes of elements with Z=102, 104, and 106, and also use of beams of ^{58}Fe, ^{64}Ni, ^{70}Zn, and ^{76}Ge ions for synthesis of superheavy elements (Z> or =108) in bombardment of targets of the lead isotopes /sup 204,206,208/Pb on the assumption that a compound nucleus is formed.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 45641

SPONTANEOUS AND INDUCED FISSION

45644 Determination of the fission cross sections of ^{238}U, ^{235}U, ^{232}Th, ^{209}Bi, $^{208-206}$Pb, ^{197}Au, ^{181}Ta, Yb, and Sm bombarded by 1-GeV protons. Bochagov, B.A.; Bychenkov, V.S.; Dmitriev, V.D.; Mal'tsev, S.P.; Obukhov, A.I.; Perfilov, N.A.; Udod, V.A.; Shigaev, O.E. (V. G. Khlopin Radium Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 291-292(Aug 1978).

The energy dependence of fission cross sections, the fission fragment angular distribution, and the fissility are a function of Z^2/A were studied in the experiment performed at the synchrocyclotron of the Leningrad Institute of Nuclear Physics.(AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

45645 (CONF-790660—2) **TDHF calculations of Kr-induced strongly damped collisions.** Davies, K.T.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

From Conference on large amplitude collective nuclear motion; Lake Balaton, Hungary (10 Jun 1979).

Time-dependent mean-field calculations, using an axially symmetric model and a Skyrme-type effective interaction, were performed for ^{84}Kr + ^{208}Pb at E/sub lab/ = 494 MeV and for ^{84}Kr + ^{209}Bi at E/sub lab/ = 600 and 714 MeV. Calculated fragment energies, mean masses, and scattering angles are in good agreement with experiment, but mass and charge distribution widths are an order of magnitude too small. In addition, TDHF calculations were recently completed for the reaction ^{86}Kr + ^{139}La at E/sub lab/ = 505, 610, and 710 MeV. At all three energies the final kinetic energy loss and angular dependence are only in fair agreement with experiment, the most serious discrepancies occurring for the large-angle (small angular momentum) fully-damped events whose calculated outgoing kinetic energies are about 50 MeV above the experimental ridge on the Wilczynski plots. Fusion is not seen at the two lower energies but for E/sub lab/ = 710 MeV fusion is obtained for angular momenta from 0 to 65 h. At E/sub lab/ = 710 MeV, emission of alpha-like particles from the neck at scission is observed for a small range of angular momenta near 100 h. 29 references.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

45646 Identification and decay of ^{242}U and ^{242}Np. Haustein, P.E.; Hseuh, H.; Klobuchar, R.L.; Franz, E.; Katcoff, S.; Peker, L.K. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **19**: No. 6, 2332-2343(Jun 1979).

The nuclides ^{242}U and ^{242}Np were discovered by chemical separations from targets of ^{244}Pu irradiated with 30—160 MeV neutrons followed by γ-ray and β-ray spectroscopy. The parent ^{242}U decays with T/sub 1/2/ = 16.8 +- 0.5 min; 14 γ rays ranging from 55.6 to 585.0 keV were assigned to its decay. The ^{242}Np daughter half-life is 2.2 +- 0.2 min and 39 γ rays following its decay have energies between 620.6 and 2370.5 keV. Q/sub β/- of ^{242}Np is 2.7 +- 0.2 MeV. A level scheme is proposed for ^{242}Pu in which the lowest 7 levels were previously described and 12 new levels are shown. The ground state of ^{242}Np is assigned I/sup [/ = 1^+ and 6 excited levels are proposed which accommodate most of the observed γ rays from decay of ^{242}U.

45647 New isotope of curium and its decay properties: ^{251}Cm. Lougheed, R.W.; Wild, J.F.; Hulet, E.K.; Hoff, R.W.; Landrum, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *J. Inorg. Nucl. Chem.;* **40**: No. 11, 1865-1869(1978).

The nuclide ^{251}Cm (t/sub 1/2/ = 16.8 +- 0.2 min) was produced by neutron capture from ^{250}Cm with an approximate cross section of 80 barns. In the decay of ^{251}Cm the energies and intensities of 12 γ-rays were measured from which a level scheme was constructed for ^{251}Bk and configurations were assigned for six single-particle states in ^{251}Bk and for the ground state of ^{251}Cm (1/2)$^+$. The levels of ^{251}Bk fed by ^{251}Cm β-decay are compared with those of ^{249}Bk fed by ^{249}Cm β-decay. The measured Q/sub β^-/ value of 1.42 MeV for ^{251}Cm was compared with previous closed-cycle estimates.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 45646, 45647

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 45646

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 45646, 45647

SPONTANEOUS AND INDUCED FISSION

45648 Measurement of the lifetime of the excited compound nucleus in the reaction $^{238}U(^{3}He, f)$ by means of the blocking effect. Apostolescu, S.; Bugrov, V.N.; Vertesh, P.; Kamanin, V.V.; Karamyan, S.A.; Macrin, R.; Oganesyan, Y.T.; Titirichi, M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 151-153(Aug 1978).

An experiment was set up to measure by the blocking effect the lifetime of the compound nucleus ^{241}Pu at excitation energy 42 MeV in the reaction $^{238}U(^{3}He,f)$. The target was a single crystal of UO_3. The shadow minima in the intensity of the reaction products were observed in the directions of the most closely packed axes <110> oriented at angles 110, 115, and 170° to the ion beam. A difference in the depths of the shadow minima was found as a function of the orientation angle of the axis. The lifetime of the compound nucleus was determined.

45649 Measurement of the time duration of the nuclear reaction $^{238}U(^{27}Al, f)$. Bugrov, V.N.; Kamanin, V.V.; Karamyan, S.A.; Tret'yakova, S.P. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 153-155(Aug 1978).

Experiments have been carried out on observation of the blocking effect in the reaction $^{238}U(^{27}Al, f)$ in a single-crystal target of UO_3 for three values of ^{27}Al ion energy: 227, 190, and 169 MeV. The effective lifetime of the compound nucleus with Z=105 is determined.

45650 Neutrons from ^{252}Cf emitted at small angles to the fission axis. Piksaikin, V.M.; D'yachenko, P.P.; Anikin, G.V.; Seregina, E.A.; Akhmedov, G.M.; Stavinskii, V.S. (Physics and Power-Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 159-160(Aug 1978).

Experimental data are reported on the angular distribution of neutrons from fission of ^{252}Cf in the range of angles $0<\theta<30°$. The results are discussed in terms of existing ideas of the mechanism of emission of prompt fission neutrons.

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 45662, 45674

45651 Method for calculating operator traces. Grimes, S.M.; Bloom, S.D.; Hausman, R.F. Jr.; Dalton, B.J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., C;* **19**: No. 6, 2378-2386(Jun 1979).

A new method is presented for the calculation of operator traces in reasonably large (N = or = 3 x 10^4) model spaces. The method is based on the approximation of a multiparticle vector vertical-bars>, which simultaneously satisfies the conditions <svertical-barO/sub i/vertical-bars> < TrO/sub i/ for a given set of commuting operators {O/sub i/], including the Hamiltonian H. An algorithm is presented for finding such an approximation to vertical-bars>, which we call vertical-bars-bar>. To illustrate the method we apply it to the calculation of TrH/sup n/ and Tr(J^2 H/sup n/), n = 0 to 8, in the model space of five nucleons in the sd shell (^{21}Ne; T = 1/2) using the Chung-Wildenthal matrix elements. The calculated results agree with exact diagonalization results to within a few percent. The method is economical in that it requires the storage of only the array vertical-bars-bar> and the relatively small arrays for the operators {O/sub i/}. It is also particularly appropriate for bit representation of both operators and vectors in terms of a Fock-space basis. An important characteristic of this method is the ease with which submanifolds of a particular symmetry and/or configuration may be projected out for study. This feature was used to calculate configuration traces for higher moments in the ^{21}Ne five-nucleon problem as well as to project out the T = 1/2 manifold

45652 Inertial character of the redisposition of the self-consistent field for large nuclear deformations. Gamalya, I.A. (Kalmyk State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 464-468(Oct 1978).

The procedure for the transfer of particles of lower levels during deformation of the nucleus is substantiated in the restricted Hartree-Fock method. The probabilities of real transitions of particles are considered. The corrections to the mass coefficients are calculated taking into account the inertial character of the redisposition of configurations in the neighborhood of level crossings of one-particle terms.

45653 Generalized Hartree-Fock-Bogolyubov approach for description of nuclear bands. Janssen, D. (Nuclear Physics Institute, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 479-487(Oct 1978).

A generalized Hartree-Fock-Bogolyubov equation is found for a set of states uniquely characterized by spin and projection. The solution of this equation is investigated in the case of small deformations and simple quadrupole forces. The relation between this method and the cranking model is established.

45654 Nuclear density fluctuations and high energy electron scattering. Burov, V.V.; Lukyanov, V.K.; Reznik, B.L.; Titov, A.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 162-167(Aug 1978).

The possible effects of nuclear density fluctuations in small volumes on electron-nucleus interactions with large momentum transfer are analyzed. The calculations of high energy elastic and deep inelastic electron-deuteron scattering agree with experiment if one assumes that the deuteron contains a few percent admixture of the fluctuon state. Such a state behaves as a six-quark object in processes with large momentum transfer. We predict qualitatively the behavior of the nuclear elastic form factors at very large momentum transfers and of the cross section for deep inelastic eA reactions.

45655 Method of generalized hyperspherical functions and properties of the ^{6}Li nucleus. Knyr, V.A.; Smirnov, Y.F. (Institute for Nuclear Physics, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 167-172(Aug 1978).

The accuracy of the method of generalized hyperspherical functions is examined on the basis of the properties of the ^{6}Li nucleus. Binding energies, electric quadrupole transition probabilities B (E2; $1^+_1 \rightarrow 3^+_1$, rms radii, and other characteristics of the ^{6}Li nucleus are calculated for 11 different central nucleon-nucleon potentials in a translationally invariant shell-model basis. The results inidcate that the minimal approximation of the method of generalized hyperspherical functions is a good basis for describing the properties of light nuclei.

45656 Study of three-particle nuclear molecular states. General formulas. Wiebicke, H.J.; Zhukov, M.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 173-177(Aug 1978).

The quantum-mechanical problem of finding the energy spectrum and wave functions of a nuclear molecule made up of three structureless particles with two identical masses and interacting with the aid of pair potentials is investigated. By changing over to Euler angles and internal degrees of freedom we obtain a Schroedinger equation that describes the rotations and oscillations of this system. It is shown that this equation yields in the limit the classical result for the oscillations of a linear molecule.

45657 Influence of spin-orbit interaction on the surface energy of a nucleus. Ivanov, Y.B. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 177-180(Aug 1978).

The coefficient of surface tension of a nucleus is calculated on the basis of the quantum-hydrodynamic theory of oscillations of a Fermi-liquid drop, with account taken of the spin-orbit interaction. It is shown that the nonlocality of the effective interaction of the quasiparticles leads to a weak dependence of the surface energy on the inclusion of the spin-orbit interaction. Good agreement is obtained between the calculated value of the surface energy and the corresponding semi-empirical value. The surface energy of the symmetry of the nucleus is calculated.

45658 Quasiclassical theory of one-body nuclear dissipation. Kolomiets, V.M. (Nuclear Research Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 186-192(Aug 1978).

The linear-response approximation is used to consider the dissipation of the collective deformation energy of a nucleus in the internal degrees of freedom. The dissipation is described with the aid of a macroscopic parameter: the nuclear-friction coefficient γ. To calculate γ in a Fermi gas of finite dimensions, a quasiclassical approximation has been developed, based on expanding the single-particle Green's function in terms of multiple reflections of the particle from the surface of the potential of the average field of the nucleus. The coefficient γ is numerically calculated for a sphere deformation of arbitrary multipolarity. Shell fluctuations of the value of γ are considered as functions of the number of nucleons in the nucleus, and an asymptotic classical limit of γ is obtained for a system with large dimensions.

NUCLEAR MATTER

45659 Compressibility of asymmetrical nuclear matter. Reizlin, V.I.; Filimonov, V.A. (Nuclear Physics Institute at the Tomsk Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 488-489(Oct 1978).

Asymmetrical nuclear matter is considered within the framework of the one-boson-exchange model. Provided that the model accounts for the energy per particle, for the density, and for the

symmetry energy of the nuclear matter, the values obtained for the compression modulus and for its symmetry part agree with the experimental ones.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 45606, 45633

45660 (KFK—2145) **FANAC: a shape-analysis program for resonance parameter extraction from neutron capture data for light and medium-weight nuclei.** Froehner, F.H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1977. 94p. Dep. NTIS (US Sales Only), PC A05/MF A01.

Work performed under United States—West Germany Fast Reactor Exchange Program.

A least-squares shape analysis program is described which is used at the Karlsruhe Nuclear Research Center for the extraction of resonance parameters from high-resolution capture data. The FORTRAN program was written for light to medium-weight or near-magic target nuclei whose cross sections are characterized, on one hand, by broad s-wave levels with negligible Doppler broadening but pronounced multi-level interference, and on the other hand, by narrow p-, d- ... wave resonances with negligible multi-level interference but pronounced Doppler broadening. Accordingly, the Reich—Moore multilevel formalism without Doppler broadening is used for s-wave levels, and a single-level description with Doppler broadening for p-, d- ... wave levels. Calculated capture yields are resolution broadened. Multiple-collision events are simulated by Monte Carlo techniques. Up to five different time-of-flight capture data sets can be fitted simultaneously for samples containing up to ten isotopes. Input and output examples are given and a FORTRAN list is appended. 8 figures.

45661 (KFK—2669) **Applied neutron resonance theory.** Forehner, F.H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Jul 1978. 79p. Dep. NTIS (US Sales Only), PC A05/MF A01.

Work performed under United States—West Germany Fast Reactor Exchange Program.

Utilization of resonance theory in basic and appications-oriented neutron cross section work is reviewed. The technically important resonance formalisms, principal concepts and methods, and also representative computer programs for resonance parameter extraction from measured data, evaluation of resonance data, calculation of Doppler-broadened cross sections, and estimation of level-statistical quantities from resonance parameters are described. 23 figures, 6 tables.

45662 (LBL—8181) **Independent particle aspects of nuclear dynamics.** Robel, M.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 290p. Dep. NTIS, PC A13/MF A01.

Thesis.

A generalization of the independent particle model from nuclear statics to nuclear dynamics is sought. Attention is centered on the average behavior of nuclear dynamics, as opposed to detailed behavior, such as that characteristic of shell effects in nuclear statics. In many situations, all that is needed is a model of dissipation in nuclear dynamics. 56 references. (JFP)

45663 (ORO—5126-57) **Dominant partition method.** Dixon, R.M.; Redish, E.F. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Mar 1979. Contract EY-76-S-05-5126. 26p. Dep. NTIS, PC A03/MF A01.

By use of the L'Huillier, Redish, and Tandy (LRT) wave function formalism, a partially connected method is developed for obtaining few-body reductions of the many-body problem in the LRT and Bencze, Redish, and Sloan (BRS) formalisms. This method for systematically constructing fewer-body models from the N-body LRT and BRS equations is termed the Dominant Partition Method (DPM). The DPM maps the many-body problem to a fewer-body one by using the criterion that the truncated formalism must be such that consistency with the full Schroedinger equation is preserved. The DPM is based on a class of new forms for the irreducible cluster potential, which is introduced in the LRT formalism. Connectivity is maintained with respect to all partitions containing a given partition, which is referred to as the dominant partition. Degrees of freedom corresponding to the breakup of one or more of the clusters of the dominant partition are treated in a disconnected manner. This approach for simplifying the complicated BRS equations is appropriate for physical problems where a few-body reaction mechanism prevails. The dominant partition truncated form of the BRS equations may be obtained by distributing the residual interaction in the exit channel in a manner consistent with the dominant partition truncations of the irreducible cluster potential. 1 figure.

45664 **Effect of tunneling on the one-body proximity friction.** Ko, C. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., C;* **19**: No. 6, 2417-2419(Jun 1979).

The first incomplete moment of the proximity flux function, used in the one-body proximity friction and diffusion, is calculated exactly in a simple model. It is seen that the usual classical approximation underestimates appreciably the exact results. This shows the importance of the quantum tunneling. Good agreements to the exact calculation can be obtained by using the Wentzel-Kramers-Brillouin approximation.

45665 **Pion sources in relativistic heavy-ion collisions.** Ta-chung, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **42**: No. 20, 1331-1335(14 May 1979).

Implications of the most recent pion-production data are discussed. It is observed that they can be used to answer some of the crucial questions raised in understanding the basic reaction mechanism of relativistic heavy-ion collisions. As a by-product of this discussion, it is shown that the volume of the pion sources in violent collisions can be determined from single-particle inclusive data. Further hadron-nucleus and nucleus-nucleus collision experiments are suggested.

45666 **Theory of the optical potential.** Zubarev, A.L. (Tashkent State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 564-566(Oct 1978).

A separable optical potential is constructed that is optimal in the sense of the Schwinger variational principle.

45667 **Correlations and self-consistency in pion scattering. I.** Johnson, M.B. (Los Alamos Scientific Lab., NM (USA)); Bethe, H.A. (Cornell Univ., Ithaca, NY (USA). Lab. of Nuclear Studies). *Nucl. Phys., A;* **305**: No. 2, 418-460(7 Aug 1978).

A new approach for calculating higher-order effects in pion multiple scattering is proposed. The theory includes nucleon-nucleon correlations and incorporates the idea of self-consistency. The theory is examined analytically in the case of nonoverlapping scatterers and it is found that: (I) higher-order terms are more moderate in size than found previously; (II) the Kisslinger anomaly cannot occur; and (III) the pion mean free path at resonance is comparable to the interparticle spacing at high density. The ideas are developed within the framework of the Foldy-Walecka theory but are applicable in more comprehensive theories.

45668 **Statistical-approach description of the decay widths and cross sections of (HI, xn) reactions for compound nuclei with Z=98, 100, and 102.** Kamanin, V.V.; Karamyan, S.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 203-208(Aug 1978).

It is shown that in the statistical approach, at a suitable choice of the temperature parameters and at fixed theoretical values of the fission barriers, it is possible to describe jointly, with good accuracy, the experimental data on the cross sections of the (HI, xn) reactions and on the lifetimes of compound nuclei with Z=98, 100, and 102 when account is taken of fission after neutron evaporation. Other possibilities of interpreting the experimental results on the lifetimes of heavy compound nuclei are also discussed.

45669 **Estimation of the cross section for the reaction $\pi^- A \to \pi^0 X$ on a heavy target nucleus with the intermediate production of a slow Δ (1240) isobar.** Davidenko, G.V.; Karmanov, V.A.; Shishov, N.N. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commission). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 216-219(Aug 1978).

The contribution from the intermediate production of a Δ isobar to the π^--meson charge-exchange reaction $\pi^- A \to \pi^0 X$ on a heavy nucleus is calculated. This mechanism results in a cross section of 1.7 mb, which is comparable with the calculated cross section for the π^--meson charge-exchange reaction $\pi^- p \to n\pi^0$ on bound protons in the xenon nucleus (~1.2 mb).

45670 **Interaction of heavy relativistic particles.** Andreev, I.V.; Chernov, A.V. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 243-246(Aug 1978).

A method is described for calculating the cross sections of heavy relativistic nuclei, and the nuclear scattering phase shifts are estimated.

45671 **Simple model of collective effects in hadron-nucleus collisions at high energies.** Zhirov, O.V.; Shuryak, E.V. (Institute of Nuclear Physics, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 247-252(Aug 1978).

Hadron-nucleus reactions at high energies are treated as a collective collision with a certain part of the nucleus, that is, an effective target whose size increases with the collision energy. The predictions of the model agree with a large set of experimental data.

Specifically, we have studied the dependence of the multiplicity on the collision energy and on the atomic number of the target, the inclusive rapidity distributions (including those in the cumulative region), the production of heavy particles (antiprotons), correlations with the number of recoil nucleons, etc.

45672 Reformulation of the strong-coupling method on the basis of the Schwinger variational principle. Zubarv, A.L. (Tashkent State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 287-289(Aug 1978).

On the basis of the Schwinger variational principle an integral equation is obtained for the problem of the elastic scattering of a particle by a nucleus (atom) at energies below threshold. All the closed channels are taken into account, and to calculate the kernel it is sufficient to know only the ground-state wave function.

RADIOACTIVE DECAY

45673 Population of the aligned rotational bands in the radiative decay of a compound nucleus. Kolomiets, V.M.; Fedotkin, S.N. (Nuclear Research Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 180-182(Aug 1978).

The effect of alignment of the nucleon angular momenta along the nuclear symmetry axis on compound nucleus radiative decay is studied. The cranking model is used to describe the alignment. It is shown that the γ-transition spectral distribution is broadened and shifted toward softer radiation when the angular momentum increases. Numerical calculations are performed for ^{209}Pb, where the dependence of the γ-ray spectral distribution on the nuclear angular momentum is calculated.

NUCLEAR MODELS

45674 Angular-momentum dependence of the statistical characteristics of n-quasiparticle nuclear excitations. Ignatyuk, A.V.; Sokolov, Y.V. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 4, 469-474(Oct 1978).

Description of the statistical characteristics of n-quasiparticle nuclear states is analyzed in the framework of the Boltzmann gas model, Fermi gas model, and nuclear superfluid model. The spin dependence of the density of such states is derived. The maximal angular momentum, for a fixed number of quasiparticles, is found.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

45675 (PB—286933) **Monte Carlo studies of electron and photon transport at energies up to 1000 MeV.** Seltzer, S.M.; Berger, M.J. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Jul 1978. 50p. NTIS PC A03/MF A01.

This report describes calculations of electron-photon showers initiated by electron beams with energies from 50 to 1000 MeV. Results obtained with the Monte Carlo program ETRAN are presented for diverse problems including: (1) the spatial distribution of energy deposited in water, air and lead targets; (2) the escape of scattered electrons and secondary bremsstrahlung from air and lead targets; (3) energy-loss straggling of primary electrons in air; (4) depth-dependent electron spectra (differential tracklength distributions) in air.

45676 Possibility of obtaining coherent x radiation when charged particles are channeled in a monocrystal. Zaretskii, D.F.; Lomonosov, V.V.; Nersesov, E.A. (Moscow Engineering-Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 209-213(Aug 1978).

Coherent effects are studied which arise when atomic x-ray transitions are excited by the Coulomb field of particles which are channeled in a monocrystal. The possibility of observing these effects experimentally is analyzed.

45677 Self-focusing of a beam of ultrarelativistic electrons in a single crystal. Kalashnikov, N.P.; Ol'chak, A.S. (Moscow Engineering-Physics Institute). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 6, 414-416(Jun 1978).

Feynman diagrams are used to calculate the probability of inverse bremsstrahlung. (AIP)

SHIELDING CALCULATIONS AND EXPERIMENTS

45678 Calculation of neutron yields released by electrons incident on selected materials. Swanson, W.P. (Stanford Linear Accelerator Center, CA (USA)). *Health Phys.;* **35**: No. 2, 353-367(Aug 1978).

Calculations are described of yields of low-energy neutrons released by electrons incident on semi-infinite slabs of natural C, Al, Fe, Ni, Cu, Ag, Ba, Ta, W, Au, Pb and U, for all incident electron energies. Yields are based on photon differential track length distributions derived for thick targets from Approximation B of analytical shower theory, with additional corrections for electron and photon propagation in the materials. The track length distributions are folded together with published photoneutron cross sections by numerical integration. When referred to unit incident electron beam power, the yield of each material exhibits a sigmoid behavior, rising from threshold to approach a constant saturation value. At high electron energies, the average trend of the neutron yield is given by 9.3 x10^{10} Z/sup +- 0.05)/ neutrons sec $^{-1}$kW^{-1}. Quantitative comparison is made to yields obtained in a separate calculation in which Approximation A is substituted for Approximation B. Comparison is made to published calculations and measurements, and radiation protection implications are discussed.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 44763, 45601

45679 (CONF-790402—21) **Mathematical behavior and computation of transmission probabilities for annular regions.** Hwang, R.N.; Toppel, B.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 21p. Dep. NTIS, PC A02/MF A01.

From Computational methods in nuclear engineering; Williamsburg, VA, USA (23 Apr 1979).

One convenient way of treating neutron transport problems is to use the transmission probability method. For cylindrical geometry consisting of many annular subregions, this method can be formulated in terms of T/sub i//sup OO/, the transmission probability from the outer-to-outer surface of the i-th annulus, and T/sub i//sup OI/, the transmission probability from the inner-to-outer surface of the i-th annulus. The quantities T/sub i//sup OO/ and T/sub i//sup OI/ are extremely complex functions of r/sub i-1//r/sub i/, the ratio of the inner-to-outer radius, and the optical path length r/sub i/Σ/sub ti/ for region i. The latter quantity can have a wide range of values in the problems of practical interest. This paper describes new, improved methods for treating these transmission probabilities on the basis of their individual mathematical properties. These improved methods have three objectives: to provide a rigorous treatment of the asymptotic behavior of these functions, which is currently lacking in the MC^2-2 code; to provide a separate treatment of T/sub i// sup OO/ and T/sub i//sup OI/ according to their distinct functional dependencies; to eliminate the two-dimensional tables currently in use to obtain these functions in the MC^2-2 code. 2 figures.

45680 (CONF-790602—59) **Determination of current weighted total cross sections in the unresolved energy region.** Barhen, J.; Cacuci, D.G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

As part of the preliminary ENDF/B-5 data testing, recommendations were made to reassess the computation of the effective point-wise current-weighted cross sections in the unresolved energy region. No previously published work has taken fully into account such important effects as interference scattering and within-sequence overlap. In addition, the extension of the unresolved region to higher energies in ENDF/B-5, in order to include competitive widths, increases the computational complexity. Because of the potential cost penalties associated with design uncertainties in large LMFBR's, it was necessary to develop a procedure which takes these effects fully into account. The new methodology presented here is to be used in the generation of multigroup libraries based on the final version of ENDF/B-5. 1 table. (RWR)

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

REFER ALSO TO CITATION(S) 45445

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

REFER ALSO TO CITATION(S) 45282, 45363

DOSIMETRY

REFER ALSO TO CITATION(S) 45254, 45451

45681 Gamma dose measurement in a d (80)+Be neutron beam. Harrison, G.H.; Cox, C.R. (Division of Radiation Research, Department of Radiation Therapy, University of Maryland School of Medicine, Baltimore, Maryland 21201). *Med. Phys.;* **6**: No. 3, 233-234(May 1979).

The γ-ray dose component of a d (80)+Be neutron beam was measured with a ^{6}Li-shielded Geiger—Mueller counter in a tissue-

equivalent liquid phantom. The proportion of γ-ray dose to total dose increased from 0.07 near the surface to 0.09 at 25 cm depth. Due to thermal neutron sensitivity, the G—M count rate increased by 25% in the absence of ^{6}Li shielding.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 45538

45682 (LA-UR—79-1071) **Ground state and elementary excitations of a model valence-fluctuation system.** Brandow, B.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 46p. (CONF-790368—1). Dep. NTIS, PC A03/MF A01.

From Sanibel symposium on quantum chemistry and solid state physics; Palm Coast, FL, USA (12 Mar 1979).

The nature of the valence fluctuation problem is described, and motivations are given for an Anderson-lattice model Hamiltonian. A simple trial wave function is posed for the ground state, and the variational problem is solved. This demonstrates clearly that there is no Kondo-like divergence; the present concentrated Kondo problem is thus more simple mathematically than the sngle-impurity problem. Elementary excitations are studies by the Green's function techniques of Zubarev and Hubbard. Quenching of local moments and a large specific heat are found at low temperatures. The quasiparticle spectrum exhibits a gap, but ϵ/sub F/ does not lie in this gap. The insulation-like feature of SmB_6, SmS, and TmSe at very low temperatures is explained in terms of a strongly reduced mobility for states near the gap, and reasons are given why this feature is not observed in other valence-fluctuation compounds. 73 references.

SUPERCONDUCTIVITY

GENERAL THEORY

45683 **Tunneling potentials associated with thermoelectric quasiparticle transport in superconductors.** Sacks, R.A. (Science Applications, Schaumberg, Illinois and Argonne National Laboratory, Argonne, Illinois). *J. Low Temp. Phys.*; **34**: No. 3, 393-407(1 Feb 1979).

A superconductor in a thermal gradient assumes a steady state with counterflowing super and normal currents. A quasiparticle transport theory is presented for this current, and the resulting nonequilibrium quasiparticle distribution function is used to discuss NIS tunneling. For zero tunneling current, we derive a bias voltage which is quadratic in delT and which is of roughly the same magnitude as the linear effect recently measured by Falco.

45684 **Nonequilibrium distributions in superconductors (Review).** Aronov, A.G.; Spivak, B.Z. (B. P. Konstantinov Institute of Nuclear Physics, Academy of Sciences of the USSR, Leningrad). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **4**: No. 11, 641-660(Nov 1978).

The present state of experimental and theoretical studies of properties of superconductors with nonequilibrium excitations is reviewed. The main equilibration mechanisms in superconductors, various steady-state nonequilibrium distributions in superconductors, results of experimental studies of nonequilibrium phenomena, possible causes of generation of inhomogeneous nonequilibrium states, and stability criteria for nonequilibrium systems are discussed.

45685 **Superconductivity of laminar semimetals.** Babichenko, V.S. (Institute of Spectroscopy, Academy of Sciences of the USSR, Troitsk, Moscow Province). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 9, 669-670(Sep 1978).

A theory is presented in which the Coulomb interaction alone between electrons is used to account for the superconducting properties of laminar semimetals. (AIP)

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 45116, 45128, 45129, 45135, 45213

45686 **Penetration of longitudinal electric fields into superconductors containing paramagnetic impurities.** Galaiko, V.P.; Glushchuk, N.I. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **4**: No. 11, 701-703(Nov 1978).

We have studied the spatial structure of the nonequilibrium current in the neighborhood of a junction between a normal metal and a superconductor containing a small concentration of paramagnetic impurities $\Delta\tau_{sf} \gg 1$, $\Delta\tau_{sf} \gg 1$. Branch mixing leads to penetration of a longitudinal electric field into the superconductor to a depth $\delta \gg \xi(T)$. Due to the energy dependence of the branch mixing frequencies, the energy distribution of the electrons in the normal metal near the junction differs from the usual one. We estimate the influence of this kinetic effect on the thermoelectric energy flux in the normal metal near the junction.

45687 **Alternating-current Josephson effect.** Zharkov, G.F.; Al'tudov, Y.K. (P. N. Lebedev Physics Institute, USSR Academy of Sciences, Moscow). *Sov. Phys. - JETP (Engl. Transl.);* **47**: No. 5, 901-906(May 1978).

An analysis is made of the problem of nonlinear oscillations which appear in a circuit containing a Josephson tunnel junction. The nonlinear ac equation, describing steady-state spontaneous oscillations in the circuit, is solved asymptotically. Numerical methods are used to find the dependence of the oscillation period on the circuit parameters. Hysteresis effects are studied and the range of their existence is determined. The form of the current-voltage characteristics of a Josephson circuit is considered in the case of a constant voltage supplied by an external power source.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 45690

45688 **Quasi-discrete states in a complex potential.** Bunatyan, G.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **28**: No. 2, 182-185(Aug 1978).

The states of the quasi-discrete spectrum of the Schroedinger equation with real and complex spherical potentials of the Woods-Saxon type is investigated. The complex eigenvalues E/sub lambda/ =ϵ/sub lambda/ +- iΓ/sub lambda//2 and complex wave functions of these states are found.

RELATIVITY AND GRAVITATION

45689 **Construction of a Riemann space—time metric for given properties of motion of test particles.** Singatullin, R.S. (Bashkir State Pedagogical Institute, Ufa). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 9, 658-660(Sep 1978).

A method for the experimental determination of the components of the Riemann metric in a co moving frame is discussed. The method involves measuring the trajectories of test particles and photons.(AIP)

STATISTICAL PHYSICS AND THERMODYNAMICS

45690 (LBL—9095) **Semiclassical statistical mechanics.** Stratt, R.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 174p. Dep. NTIS, PC A08/MF A01.

Ph. D. Thesis.

On the basis of an approach devised by Miller, a formalism is developed which allows the nonperturbative incorporation of quantum effects into equilibrium classical statistical mechanics. The resulting expressions bear a close similarity to classical phase space integrals and, therefore, are easily molded into forms suitable for examining a wide variety of problems. As a demonstration of this, three such problems are briefly considered: the simple harmonic oscillator, the vibrational state distribution of HCl, and the density-independent radial distribution function of He^4. A more detailed study is then made of two more general applications involving the statistical mechanics of nonanalytic potentials and of fluids. The former, which is a particularly difficult problem for perturbative schemes, is treated with only limited success by restricting phase space and by adding an effective potential. The problem of fluids, however, is readily found to yield to a semiclassical pairwise interaction approximation, which in turn permits any classical many-body model to be expressed in a convenient form. The remainder of the discussion concentrates on some ramifications of having a phase space version of quantum mechanics. To test the breadth of the formulation, the task of constructing quantal ensemble averages of phase space functions is undertaken, and in the process several limitations of the formalism are revealed. A rather different approach is also pursued. The concept of quantum mechanical ergodicity is examined through the use of numerically evaluated eigenstates of the Barbanis potential, and the existence of this quantal ergodicity - normally associated with classical phase space - is verified. 21 figures, 4 tables.

ELECTRICITY AND MAGNETISM

45691 (SAND—78-7069) **Backscatter response of roads and roadside surfaces.** Stiles, W.H.; Ulaby, F.T.; Wilson, E. (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract EY-76-C-04-0789. 142p. Dep. NTIS, PC A07/MF A01.

The angular response of the radar backscattering coefficient σ^0 was measured by the high-frequency-band Microwave Active Spectrometer (MAS 8-18/35) for concrete, asphalt, dirt, and gravel surfaces and for short and tall grass at 8.6 GHz, 17.0 GHz, and 35.6 GHz. The measurements were made over the 0° (nadir) to 80° range in angle of incidence for each of the three linear polarization configurations, HH, HV, and VV. In addition, the 35.6 GHz channel measured σ^0 for RL and RR configurations. The measurements were made in two phases. The first phase covered the concrete, asphalt, gravel, and grass targets over the above angular range and some special scan data sets. Scan recordings of σ^0 were made at 50°, where in this mode the antenna is made to scan in azimuth over an approximately 90° angle. The scan measurements are used to determine the change in σ^0 at the boundary between two dissimilar surfaces, such as an asphalt road and its roadside material, or to determine the change in σ^0 as the beam scans over a hard target positioned on the road surface. Scan measurements of several combinations of surfaces were conducted including dry concrete/grass, wet concrete/grass, dry asphalt, grass, wet asphalt/grass and car on asphalt. In terms of separability between targets, 8.6 GHz performed best among the three frequencies; and among the three polarization configurations, HH and HV performed equally well and always better than VV. In the second phase, additional targets were observed to cover a larger variety of road and right-of-way conditions. 24 figures, 4 tables.

FUSION ENERGY

45692 Technology index for plasmaphysics research and fusion reactors. *Tech.-Index Plasmaphys. Forsch. Fusionsreakt.;* **12**: No. 10, 58(1978).

This listing contains 279 references on various aspects of plasma physics and controlled fusion research. Subject and author indexes are included. (MOW)

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

45693 (N—78-29912) **A heating mechanism of ions due to large amplitude coherent ion acoustic wave.** Yajima, N.; Kawai, Y.; Kogiso, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1978. 31p. NTIS PC A03/MF A01.

The ion heating mechanism in a plasma with a coherent ion acoustic wave was studied experimentally and numerically. Ions are accelerated periodically in the electrostatic potential of the coherent wave and their oscillation energy is converted into the thermal energy of ions through the collision with the neutral atoms in plasma. The Monte Carlo calculation is applied to obtain the ion temperature. The amplitude of the electrostatic potential, the mean number of collisions and the mean life time of ions are treated as parameters in the calculation. The numerical results are compared with the experiments and are in good agreement. The ion temperature is found to increase as the amplitude of the coherent wave increases. The high energy tail in the distribution function of ions are observed for the case of large wave-amplitude.

45694 (N—78-29913) **Anomalous ion loss by low frequency instabilities.** Inoue, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1978. 11p. NTIS PC A02/MF A01.

The ambipolarity formula for the cross-field flux of the non-uniform plasma in the presence of the low frequency electromagnetic fluctuations is presented. Because of the ion polarization drift, the ions are pulled out by the diffusing electrons so that the ambipolarity of the flux is maintained independent of the finite ion Larmor radius effect.

45695 (ORNL/TM—6820) **Electron energy confinement in ELMO Bumpy Torus (EBT).** Hiroe, S.; Haste, G.R.; Dandl, R.A. (Nagoya Univ. (Japan); General Atomic Co., San Diego, CA (USA)). Jun 1979. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

Using a calibrated, solid-state, soft x-ray detector, the electron temperature and density have been measured over a wide range of operating conditions of ELMO Bumpy Torus (EBT). The empirical relations of the temperature or the density to the microwave power and the ambient pressure have been determined. The toroidally stored energy has been observed to increase as the stored energy of the hot electron annulus increases. The energy confinement time has been obtained for various plasma parameters and has been found to agree with the neoclassical theory. The advantages of EBT collisionless scaling for fusion plasma confinement have been noted, i.e., n/sub e/tau/sub E/ increases as T/sub e/$^{1.5}$ in the collisionless regime.

45696 Velocity space ring-plasma instability, magnetized, Part I: Theory. Lee, J.K.; Birdsall, C.K. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Phys. Fluids;* **22**: No. 7, 1306-1314(Jul 1979).

The interaction of magnetized monoenergetic ions (a ring in velocity space) with a homogeneous Maxwellian target plasma is studied numerically using linear Vlasov theory. The ring may be produced when an energetic beam is injected perpendicular to a uniform magnetic field. In addition to yielding the previously known results, the present study classifies this flute-like instability into three distinct regimes based on the beam density relative to the plasma density, where many features such as physical mechanisms, dispersion diagrams, and maximum growth rates are quite different. The effects of electron dynamics, plasma or ring thermal spread, the ratio of ω/sub p//ω/sub c/ for plasma ions, and electromagnetic modifications are also considered.

45697 Recent progress in tokamak experiments. Murakami, M.; Eubank, H.P. (Oak Ridge National Laboratory). *Phys. Today;* **32**: No. 5, 25-32(May 1979).

Plasmas confined by magnetic fields in a toroidal geometry can reach confinement times, densities and temperatures approaching those needed for producing useful fusion energy.

45698 Adiabatic plasma heating and fusion-energy production by a compressible fast liner. Gerwin, R.A.; Malone, R.C. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Fusion;* **19**: No. 2, 155-177(1979).

Adiabatic plasma heating by the implosion of a compressible, cylindrical, end-plugged liner is studied by means of an approximate analytical model and by a computer code that employs sophisticated equation-of-state tables for the metal liner. The model contains cylindrical convergence effects and an approximate but realistic equation-of-state. Analytic expressions are derived for the pressure profile in the liner, for the internal energy of the liner, for the maximized fusion energy output of the enclosed D-T plasma, for the corresponding optimized initial conditions, and for the resulting peak pressure, final radius and thickness, and burn time. In this idealized model that ignores losses, energy transfer efficiencies (liner to plasma) of 70% are found, and a gain of 4 (ratio of fusion energy to liner energy) can occur with an initial liner energy of 300MJm^{-1}. Finally, losses from the plasma are briefly discussed.

45699 Particle orbits in field-reversed mirrors. Wang, M.Y.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). *Nucl. Fusion;* **19**: No. 1, 39-49(1979).

The particle orbits in field-reversed mirrors (FRM) are studied. It is found that the orbit can be expressed in terms of the first and third kind of elliptic integral for particles moving in the centre plane of the Hill vortex configuration. Requirements for absolute confinement are obtained, and four distinct classes of orbits are identified that are bounded by limits on the canonical angular momentum Psub(theta). The improvement in confinement over a simple mirror as well as natural divertor properties of the FRM are illustrated by these results.

45700 New pinch effect and electron heat loss for tokamak plasmas. Ware, A.A.; Hazeltine, R.D.; Wiley, J.C. (Texas Univ., Austin (USA). Fusion Research Center). *Nucl. Fusion;* **19**: No. 2, 271-275(1979).

A new pinch effect is reported for low-energy electrons in the presence of electrostatic trapping. Towards the collisional end of the plateau regime it is predicted to be significantly larger than the normal neoclassical pinch effect and it will help to explain the anomalous plasma pinching observed in gas-puffing experiments.

45701 Observation of 1 MeV electrons in a plasma heated by a CO_2 laser. Boiko, V.A.; Danilychev, V.A.; Zvorykin, V.D.; Pikuz, S.A.; Faenov, A.Y.; Kholin, I.V.; Chugunov, A.Y. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 556-557(Nov 1978).

The maximum energy, angular distribution, and intensity of fast electrons emitted by the nonequilibrium plasma produced by a CO_2 laser operating in the "plasma-mirror" mode were measured.(AIP)

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 45695

45702 Resonance-fluorescence measurement of the atomic hydrogen radial profile in the FT-1 tokamak. Burakov, V.S.; Lebedev, A.D.; Misakov, P.Y.; Naumenkov, P.A.; Nechaev, S.V.; Razdobarin, G.T.; Semenov, V.V.; Sokolova, L.V.; Folomkin, I.P. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 549-550(Nov 1978).

The sensitivity of the resonance-fluoresence method was improved by increasing the length of the laser pulse (λ=6563 A).

PLASMA KINETICS - GENERAL

45703 (N—78-29915) **Radiation phenomena of plasma waves. part 1: fundamental radiation theory.** Ohnuma, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1978. 43p. NTIS PC A03/MF A01.

Fundamental radiation theory is examined and both theoretical and experimental investigations of radiation properties in plasmas are reviewed. Experiments on radiation from point sources are discussed with simplified theoretical considerations. Experiments on radiation from finite sources include summarized theoretical results.

45704 **Diffusion of resonance particles in ambipolar plasma traps.** Ryutov, D.D.; Stupakov, G.V. (Institute of Nuclear Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 6, 412-414(Jun 1978).

An expression for the diffusional flux is obtained assuming their mean free path is much larger than the length of the central mirror trap. (AIP)

PLASMA KINETICS - EXPERIMENTAL

45705 (N—78-33931) **Monotone steady-state potential distributions in the standard collisionless plane diode model of the single-ended q-machine.** Kuhn, S.; Auer, G.; Mravlag, E. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). Jul 1978. 55p. NTIS PC A04/MF A01.

Nine types of monotone potential distributions are distinguished and the corresponding parameter domains given. A symmetry transformation is introduced by means of which the properties of monotone increasing distributions are easily deduced from those found for monotone decreasing ones. Several sets of parameter curves of practical importance are discussed, among them the curves of constant plasma density, of constant plasma potential, of constant neutral flux towards the hot plate, and of zero net current. Examples of application are given which demonstrate that the steady-state conditions are extremely sensitive to the ionic and hot-plate properties. Possibilities of determining experimental potential distributions are discussed.

PLASMA KINETICS - THEORETICAL

45706 (CONF-790469—1) **One-dimensional transport solutions for EBT-II.** Jaeger, E.F.; Hedrick, C.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 101p. Dep. NTIS, PC A06/MF A01.

From 1979 Sherwood meeting; Mt Pocono, PA, USA (18 Apr 1979).

Recently one-dimensional radial transport solutions for the ELMO Bumpy Torus (EBT-I) have been obtained in the collisionless electron regime as observed in experiments. In these calculations, resonant diffusion of ions is included in regions where poloidal drift frequencies are small. For ion temperatures characteristic of EBT-I, this leads to ion transport coefficients which are approximately independent of collisionality (plateau regime). In this paper we extend these calculations to the higher temperature and density regime proposed for the EBT-II experiment. Results show somewhat hollow density profiles in steady state due to the presence of off-diagonal neoclassical transport coefficients. In addition, the sputtered flux of aluminum due to charge exchange neutrals in EBT-II is increased by a factor of 20 to 30 over that found in EBT-I calculations.

45707 (CONF-790645—3) **Some thoughts on the p(^{6}Li, α)^{3}He(^{6}Li, p)^{8}Be chain reaction, plasma theory memo # 79/18.** McNally, J.R. Jr.; Rothe, K.E. (Oak Ridge National Lab., TN (USA)). 10 Apr 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

From IEEE international conference on plasma science; Montreal, Canada (4 Jun 1979).

This memo contains viewgraphs on p^{6}Li chain reaction prospects, intended for presentation in part at the 1979 IEEE International Conference on Plasma Science, Montreal, Canada, June 4—6, 1979.

45708 (DOE/ET—0096) **Final report of the ad hoc committee on TFTR physics.** Clarke, J.F. (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 36p. Dep. NTIS, PC A03/MF A01.

This report is a thorough scientific review of the TFTR physics situation. This review was intended to provide a reference point from which to develop future ETM policy toward the Engineering Test Facility (ETF) development program and to define possible modifications to the TFTR program to better support the ETF.

45709 (DOE/ET—0099) **Magnetic fusion theory effort.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 104p. Dep. NTIS, PC A06/MF A01.

The present publication is a comprehensive listing of the magnetic fusion theory effort. It updates the last publication, ERDA 77-18, and gives data on the FY 1977 and FY 1978 budgets. There is a section devoted to the National Magnetic Fusion Computer Center.

45710 (EPRI-ER—1032) **Tokamak reactor codes: MAK0 and MAK1. Final report.** Byrne, R.N.; Klein, H.H.; Stuart, G.W.; Wagner, C.E. (Science Applications, Inc., La Jolla, CA (USA)). Mar 1979. 147p. Dep. NTIS, PC A07/MF A01.

We are developing a series of computer codes (MAK0, MAK1, MAK2) which realistically model the performance of tokamak reactors in 0, 1, and 2 dimensions. Versions of MAK0 and MAK1 are operational and described in this report. They solve the time evolution of the density and energy conservation equations in D-T plasmas with alphas, neutrals, and two impurity species. MAK1 solves the plasma equilibrium equation on the Lagrangian flux-coordinate grid with transport coefficients computed as surface average quantities which include Pfirsh—Schulter, neoclassical, and trapped particle effects. Plasma recycle and impurity injection are self-consistent with charged particle and neutron outflow. An average ion coronal model determines impurity charges. Major radius control and plasma scrapeoff by a limiter are modeled. These codes are applicable to a wide variety of physics or engineering studies of tokamak reactors.

45711 (N—78-29911) **Monte carlo simulation of the classical two-dimensional one component plasma.** Gann, R.C.; Chakravarty, S.; Chester, G.V. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). 1978. Contracts NGR-33-010-188;NSF DMR-76-81083. 56p. NTIS PC A04/MF A01.

Monte Carlo simulation, lattice dynamics in the harmonic approximation, and solution of the hypernetted chain equation were used to study the classical two-dimensional one component plasma. The system consists of a single species of charged particles immersed in a uniform neutralizing background. The particles interact via a l/r potential, where r is the two dimensional separation. Equations of state were calculated for both the liquid and solid phases. Results of calculation of the thermodynamic functions and one and two particle correlation functions are presented.

45712 (N—78-29914) **High-pressure equilibria of a small-aspect-ratio tokamak.** Yamazaki, K.; Uchida, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1978. 19p. NTIS PC A02/MF A01.

Axisymmetric sharp-boundary toroidal equilibria with high pressure are investigated to the second order in the inverse aspect ratio expansion. The second order effects of anisotropic plasma pressure and toroidal mass flow on toroidal equilibria are also analyzed with the quasi-uniform current model.

45713 (N—78-29917) **Introduction to the kinetic theory of plasma turbulence.** Ludwig, G.O. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Feb 1978. 38p. NTIS PC A03/MF A01.

Various aspects in the theory of turbulence in collisionless plasmas were studied. Nonlinear theory was used to describe low turbulence plasmas which intially develop from a form that extends to the theory of strong turbulence plasmas. This extension utilizes the concept of orbit perturbations in the turbulent boundary layer.

45714 **Neoclassical transport in plasmas containing ions with multiple charge states.** Boley, C.D.; Gelbard, E.M.; Hirshman, S.P. (Applied Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Fluids;* **22**: No. 7, 1280-1283(Jul 1979).

It is shown that in the calculation of the Spitzer function and the Pfirsch—Schlueter transport coefficients for a multispecies tokamak plasma, a considerable analytic simplification occurs for the case of ions with multiple charge states. The number of coupled integrodifferential equations to be solved can be reduced from the total number of species (each charge state constitutes a distinct species) to the number of ions with different nuclei. The solutions are expressed in terms of quantities characterizing a system of interacting electrons and ion aggregates.

45715 **Collisionless plasma expansion into a vacuum.** Denavit, J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Fluids;* **22**: No. 7, 1384-1392(Jul 1979).

Particle simulations of the expansion of a collisionless plasma into vacuum are presented. The cases of a single-electron-temperature plasma and of a two-electron-temperature plasma are considered. The results confirm the existence of an ion front and verify the general features of self-similar solutions behind this front. A cold electron front is clearly observed in the two-electron-temperatures case. The computations also show that for a finite electron-to-ion mass ratio, m/sub e//m/sub i/, the electron thermal velocity in the

expansion region is not constant, but decreases approximately linearly with $\xi<x/t$, where x is distance and t is time. A self-similar solution, derived from the relation T/sub e/n/sup 1-gamma//sub e/ <const, where T/sub e/ is the electron temperature, n/sub e/ is the electron density, and γ is a constant (instead of the isothermal assumption made in earlier theories), yields a linearly decreasing ion acoustic speed, $c_a=c_0-(\gamma-1)\,\xi/2$, and comparison with computer simulation results show that the constant γ-1 is proportional to (Zm/sub e//m/sub i/)@sup 1/2@, where Z is the ion charge number.

45716 Alpha transport and blistering in tokamaks. Bauer, W.; Wilson, K.L.; Bisson, C.L.; Haggmark, L.G. (Sandia Labs., Livermore, CA (USA)); Goldston, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* **19**: No. 1, 93-103(1979).

The particle flux and angular distribution of 3.5 MeV alpha particles impinging on the first wall from uncontained banana orbits in an axisymmetric tokamak reactor have been calculated. The resulting helium concentration profiles in the first wall can give rise to surface exfoliation under specified conditions. The major mitigating factor is the simultaneous surface recession due to sputtering by the D-T charge-exchange neutral flux. For the parameters used in these calculations blistering in high-sputtering-rate materials such as beryllium is unlikely, whereas in low-sputtering-rate materials such as niobium helium-induced surface deformation is quite probable.

45717 Kinetic fluctuations in a partially ionized plasma and in chemically reacting gases. Belyi, V.V.; Klimontovich, Y.L. (Institute of Terrestrial Magnetism and Radiowave Propagation, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **47**: No. 5, 866-869(May 1978).

A kinetic theory is developed of the fluctuations in a partially ionized plasma and in chemically reacting gas systems. It is a generalization of the previously developed kinetic theory of fluctuations in simple gases and in a fully ionized plasma. The obtained general relations are used to calculate the intensities of the Langevin sources in the equations for the concentrations of the electrons, ions, and atoms in a partially ionized plasma with a uniform distribution of the particles.

45718 (UCRL-Trans—11475) **Homogeneous model of resonance diffusion of particles in an open magnetic trap.** Chirikov, B.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1978. Translation of Preprint IYAF—78-67, pp 1-33. 42p. Dep. NTIS, PC A03/MF A01.

A simple model of the transverse diffusion of particles in an axially nonsymmetric open trap is discussed. The model is convenient for both analytical investigation and numerical calculation. The model takes into account the dynamics of the motion of an individual particle, as well as the multiple scattering of such a particle from stationary centers of fixed density. On the basis of the homogeneous model, the mechanism of resonance diffusion in different ranges of the values of the parameters is determined; and simple estimates are obtained for the rate of diffusion.

PLASMA PRODUCTION

45719 Uniformly redundant array imaging of laser driven compressions: preliminary results. Fenimore, E.E.; Cannon, T.M.; Van Hulsteyn, D.B.; Lee, P. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Appl. Opt.;* **18**: No. 7, 945-947(1 Apr 1979).

The preliminary results of the code aperture imaging experiments conducted at the Los Alamos two-beam CO_2 laser system are reported.(AIP)

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 45697

45720 (DOE/ET—0097) **Trapped particle instabilities workshop.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 20p. Dep. NTIS, PC A02/MF A01.

A workshop was held to review the past history, present status and future directions of the field of trapped particle instabilities. The discussion included the relative contribution to anomalous transport by trapped particle and other low-frequency microinstabilities. It is recommended that continuing support should be provided for microinstability theory, including that of trapped particle modes. The emphasis should be placed on the identification of physically important modes and their relation to transport.

45721 Current-driven drift modes in sheared magnetic field. Gladd, N.T.; Liu, C.S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **22**: No. 7, 1289-1296(Jul 1979).

The radial eigenmode problem for current-driven drift modes in a plasma slab with sheared magnetic field is solved including the full electron dynamics and effects of electron temperature gradient and electron-ion collisions. Particular attention is given to the eigenmode structure and comparisons with the universal drift mode are made. The threshold current for the onset of current-driven drift mode is found to be close to that predicted by analytic theory and not greatly affected by electron temperature gradient or collisionality.

45722 Velocity space ring-plasma instability, magnetized, Part II: Simulation. Lee, J.K.; Birdsall, C.K. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Phys. Fluids;* **22**: No. 7, 1315-1322(Jul 1979).

The ring-plasma instability arising due to two-energy component ions of a homogeneous plasma in a uniform magnetic field is studied through use of electrostatic and electromagnetic simulations, treating the ring ions as particles and the target plasma (ions and electrons) as linearized fluids. Simulation results verify very closely the predictions of the linear Vlasov theory and provide extensive information on nonlinear features such as beam spreading, slowing down, and saturation, some of which are in agreement with analytic explanations. This nonlinear evolution occurs before Coulomb collisions take place, and may be considered as the initial condition for Fokker—Planck calculations. The justification for using a linearized fluid is also discussed.

45723 Preliminary investigation of trapped-particle instabilities in EBT. Batchelor, D.B.; Hedrick, C.L. (Oak Ridge National Lab., TN (USA)). *Nucl. Fusion;* **19**: No. 2, 235-248(1979).

An investigation is presented of the role which trapped particles might play in the drift-wave stability of the ELMO Bumpy Torus (EBT). The model adopted consists of a bounce-averaged drift-kinetic equation with a Krook collision operator. Care has been taken to model, at least in an elementary way, the features which distinguish the physics of EBT from that of tokamaks, namely the large magnitude and velocity-space dependence of the poloidal drift frequency Ω, the relatively small collisionality ν/Ω, the enhancement of $\nu_{sub(eff)}$ for passing particles, and the closed nature of the field lines. Instabilities are found which have a somewhat dissipative character; however, the precessional drift is found to be a significant stabilizing influence. In most cases the modes are completely stabilized when $\omega_{sub(*)}/|\Omega$ approximately <1 for normal gradients. For reversed gradients ($\omega_{sub(*)}/|\Omega<0$), stability is greatly enhanced.

45724 Local theory of finite-β, collisional drift modes. Dominguez, R.R. (California Univ., Berkeley (USA)). *Nucl. Fusion;* **19**: No. 1, 105-107(1979).

The stability of the collisional drift-Alfven mode, in a shearless magnetic field, is investigated in the local approximation. In the absence of temperature gradients, it is shown that the β-threshold for stability in a collisional, finite-β plasma is essentially the same as the collisionless results, $\beta>0.15$.

45725 Anomalous drift-wave transport analysis of tokamak discharges. Horton, W.; Estes, R.D. (Texas Univ., Austin (USA). Dept. of Physics). *Nucl. Fusion;* **19**: No. 2, 203-222(1979).

The drift-wave model of anomalous transport is used to interpret electron energy balance in discharge data from five tokamaks. A consistent interpretation requires the inclusion of impurity radiation losses which, in some cases, become comparable with the Ohmic power input. For discharges with a well-defined radial electron thermal flux the value of the coefficient in the drift-wave transport formula is determined along with bounds on the variation of the coefficient that are consistent with the interpretation of the data.

45726 Space-dependent thermal stability of reacting tokamak plasmas. Houlberg, W.A.; Conn, R.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). *Nucl. Fusion;* **19**: No. 1, 81-92(1979).

A technique is presented for the analysis of thermal stability in reacting tokamak plasmas using a one-dimensional, time-dependent fluid transport model. Application is made to the analysis of density-related thermal instabilities in a neutral-beam-driven, two-component plasma (TETR) and a conceptual reactor-size ignited plasma (UWMAK-III). A density-driven thermal instability can exist when the particle confinement varies as $\tau_{sub(p)}$ proportional to n. This condition is satisfied by the trapped-ion-mode diffusion model and an empirical model. A time delay in the heating due to finite alpha thermalization does not significantly alter the character of the instability at normal plasma densities. A linear feedback response for the particle source is found to provide a stabilized equilibrium in all cases. Strong radial variation of the transport and physical properties of the plasma is not found to introduce radial-dependent feedback requirements. Feedback on the average density is sufficient for stabilization with moderate response times.

PLASMA WAVE PHENOMENA

45727 Resistive drift-Alfven waves in sheared magnetic fields. Catto, P.J.; Rosenbluth, M.N.; Tsang, K.T. (Science Applications,

Inc., Laboratory for Applied Plasma Studies, Boulder, Colorado 80302). *Phys. Fluids;* **22**: No. 7, 1284-1288(Jul 1979).

A new class of resistive drift-Alfven modes is discovered. The new modes are believed to be the generalization of shear-Alfven waves to sheared magnetic fields. In addition, the finite β (plasma over magnetic pressure) corrections to the electrostatic dissipative drift wave are evaluated.

45728 Energy flow and absorption along resonance cones near the lower hybrid. Grabbe, C.L. (Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee 37916). *Phys. Fluids;* **22**: No. 7, 1323-1328(Jul 1979).

Macroscopic and microscopic forms of the energy conservation theorem for quasi-static waves are applied to determine the approximate power flux density and rate of energy absorption along the resonance cones near the lower hybrid resonance, both for the incoming cone and the outgoing converted ion thermal cone. It is found that for the incoming cone excited by a point gap source, there is almost as much power flux and absorption along each of the first few secondary peaks as along the main peak, so that the channel along which most of the energy flow and absorption occurs extends the width of several peaks of the cone. On the outgoing cone, the power flow and absorption is more concentrated on the main peaks than for the incoming cone. Nonlinear ponderomotive force effects are found to be more important, in general, for this cone than the incoming cone unless substantial absorption occurs in the mode conversion region. An asymptotic relationship is found connecting the power absorbed to the power flux and the spatial damping rate of the potential of the resonance cones.

45729 Conversion between cold plasma modes in an inhomogeneous plasma. Weitzner, H.; Batchelor, D.B. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10003). *Phys. Fluids;* **22**: No. 7, 1355-1358(Jul 1979).

For a particular angle of incidence, it is possible for an ordinary mode electromagnetic wave, incident on an inhomogeneous plasma slab, to be totally converted into an extraordinary mode. A previous analysis of this process has been extended to permit an arbitrary angle of incidence and to include magnetic field gradients. Although this process has recently been proposed as a method by which toroidal plasmas might be electron cyclotron heated from the outside (low magnetic field region), it was found that for plasma parameters characteristic of modern tokamaks, significant mode conversion occurs only for waves incident within a very narrow cone ($\delta\theta \sim 1^{\circ}$) about the critical angle. Also addressed is the question of the location at which ordinary/extraordinary mode conversion occurs.

45730 Interaction of a low density runaway beam with cavity modes. Morales, G.J. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Fluids;* **22**: No. 7, 1359-1371(Jul 1979).

An idealized problem is investigated which illustrates the role of wave-particle interactions in the evolution of runaway beams. The model considers the interaction between a weak cold beam, driven by an external static electric field E, and waves quantized by the geometry. The waves may correspond to Gould—Trivelpiece modes fixed by the length of the experimental device, or to the finite length of the experimental device, or to the finite Fourier modes encountered in computer simulations. The physics consists of the sweeping of the accelerated beam through the resonance provided by each cavity mode. This process is formulated in analogy with the O'Neil—Winfrey—Malmberg problem but uses a spatially averaged description based on the exact energy and momentum conservation laws with the dynamics simplified through a WKB representation of the dispersion relation. This model shows that the beam can be clamped in velocity with the momentum push being transferred to the waves. The model has been extended to the relativistic and multi-mode cases. For $E<0$ the nonrelativistic results are in good agreement with the work of O'Neil, et al., while in the relativistic case the model reproduces the nontrivial features of the computer study by Lampe and Sprangle.

45731 Computer model for bounded plasma. Decyk, V.K.; Dawson, J.M. (Department of Physics, University of California, Los Angeles, California 90024). *J. Comput. Phys.;* **30**: No. 3, 407-427(Mar 1979).

A computer model is developed for simulating a bounded plasma slab. The two dimensional electrostatic model is periodic in one dimension and bounded in the other. In the non-periodic dimension, one can specify values of the potential or the normal electric field on both boundaries, or one can specify that a vacuum exists outside the plasma or any combination of these on each boundary. The plasma model can be non-neutral. Because the final solution has a particularly simple form, it can be obtained with only one Fast Fourier Transform, and therefore this model is only slightly slower than conventional doubly periodic models. External electrostatic sources, either on the boundaries or in the plasma interior, can be added in a natural way. The computer model is tested by examining the propagation of linear waves in a plasma slab bounded by vacuum. The predictions of a dispersion relation based on a warm fluid model are compared with the results obtained from the computer model, with very good agreement for the real parts of the frequencies.

45732 Excitation of resonances in a toroidal plasma confinement system. Longinov, A.V.; Stepanov, K.N. (Physics Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 11, 523-525(Nov 1978).

The excitation of magnetosonic waves by current sheets at the plasma-vacuum interface is considered theoretically.(AIP)

45733 Passage of wave of finite amplitude through plasma wave barrier. Krasovskii, V.L.; Oraevskii, V.N. ("Energiya" Scientific-Manufacture Association, Moscow). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 9, 674-675(Sep 1978).

One-dimensional calculations are performed for the phase mixing of a Langmuir wave propagating through a plasma with a density barrier. (AIP)

45734 Radiation pressure on charged particles in stimulated inverse bremsstrahlung. Pashinin, P.P.; Fedorov, M.V. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Phys. - JETP (Engl. Transl.);* **48**: No. 2, 228-232(Aug 1978).

An investigation is made of the distribution of the photon momentum between subsystems of colliding particles in the course of stimulated inverse bremsstrahlung of light in an isotropic plasma. The general case of an arbitrary ratio of the charges and masses of particles is considered. The mass ratio corresponding to the complete absorption of the momentum by the lighter particles is found. It is shown that the pressure forces exerted on electrons and ions in an electron—ion plasma are, respectively, parallel and antiparallel to the direction of wave propagation. The density of the electric current representing the photon drag of charged particles is calculated.

45735 Nonlinear theory of excitation of monochromatic waves in a magnetoactive plasma by a relativistic beam of charged particles. Kitsenko, A.B.; Pankratov, I.M. (Physico-Technical Institute of the Academy of Sciences of the Ukrainian SSR, Khar'kov). *Sov. Phys. - JETP (Engl. Transl.);* **48**: No. 2, 243-247(Aug 1978).

A nonlinear theory of the excitation of monochromatic electromagnetic waves of arbitrary polarization in a magnetoactive plasma by a monoenergetic relativistic beam of low density is presented. It is shown that the beam-plasma interaction is most effective when the component of the phase velocity of the excited waves along the external magnetic field is close to the velocity of light (in vacuo). In this case the maintenance of Cerenkov or cyclotron resonance of the beam particles is enhanced. An energy comparable to the incident kinetic energy of the beam may be transferred to the plasma oscillations.

45736 Experimental investigation of the interaction of an electromagnetic field with a plasma layer. Brodskii, Y.Y.; Gol'tsman, V.L.; Mironov, V.A.; Nechuev, S.I. (Applied Physics Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **47**: No. 5, 853-860(May 1978).

The effect of nonlinear transparency of a plasma layer in the field of an intense electromagnetic wave is investigated experimentally. It is observed that the plasma bleaching is accompanied by an anisotropic change of the distribution function, wherein the maximum number of fast particles is observed in a direction parallel to the projection of the wave field on the surface of the plasma layer. The bleaching process has a nonstationary character. The results are interpreted theoretically. It is shown that the main characteristics of the effect are well explained by assuming that a modulation instability develops in the plasma and leads to excitation of nonlinear Langmuir waves.

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 45104

45737 (WFPS-TME—107) **Conceptual design of a Demonstration Tokamak Hybrid Reactor (DTHR), September 1978.** Kelley, J.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Dec 1978. Contract EG-77-C-02-4544. 195p. Dep. NTIS, PC A09/MF A01.

The flexibility of the fusion hybrid reactor to function as a fuel production facility, power plant, waste disposal burner or combinations of all of these, as well as the reactor's ability to use proliferation resistant fuel cycles, has provided the incentive to assess the feasibility of a near-term demonstration plant. The goals for a Demonstration Tokamak Hybrid Reactor (DTHR) were estab-

lished and an initial conceptual design was selected. Reactor performance and economics were evaluated and key developmental issues were assessed. The study has shown that a DTHR is feasible in the late 1980's, a significant quantity of fissile fuel could be produced from fertile thorium using present day fission reactor blanket technology, and a large number of commercially prototypical components and systems could be developed and operationally verified. The DTHR concept would not only serve as proof-of-principle for hybrid technology, but could be operated in the ignited mode and provide major advancements for pure fusion technology.

BLANKET ENGINEERING

45738 (ANL—78-109) **Current status of fusion reactor blanket thermodynamics.** Veleckis, E.; Yonco, R.M.; Maroni, V.A. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 34p. Dep. NTIS, PC A03/MF A01.

Recent studies of liquid lithium have concentrated on its sorption characteristics for hydrogen isotopes and its interaction with common impurity elements. Hydrogen isotope sorption data (P-C-T relations, activity coefficients, Sieverts' constants, plateau pressures, isotope effects, free energies of formation, phase boundaries etc.) are presented in a tabular form that can be conveniently used to extract thermodynamic information for the α-phase of the Li-LiH, Li-LiD, and Li-LiT systems and to construct complete phase diagrams. Recent solubility data for Li_3N, Li_2O, and Li_2C_2 in liquid lithium are discussed with emphasis on the prospects for removing these species by cold-trapping methods. Current studies on the sorption of hydrogen in solid lithium alloys (e.g., Li—Al and Li—Pb), made using a new technique (the hydrogen titration method), have shown that these alloys should lead to smaller blanket-tritium inventories than are attainable with liquid lithium and that the P-C-T relationships for hydrogen in Li—M alloys can be estimated from lithium activity data for these alloys.

45739 (GA-A—15365) **Thermal—hydraulic considerations in magnetically confined fusion reactors.** Kearney, D.W. (General Atomic Co., San Diego, CA (USA)). Jan 1979. Contract EY-76-C-03-0167-038. 15p. (CONF-790802—13). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

This paper emphasizes the structural-related thermal problems that have developed from work on the tokamak and mirror concepts, though many of the important considerations are generic to all magnetic fusion systems. The thermal loads due to alpha particle energy deposition on the first wall and the energy deposited by neutron interaction as volumetric heating place substantial cooling requirements on many components of a fusion reactor, e.g., coils, blankets, shields and first walls. The main subject of this paper is the high temperature region in close proximity to the plasma - the first wall and blanket. Heat fluxes, temperatures and temperature fluctuation are highest in these components, possibly leading to creep rupture and thermal fatigue. Some of the design solutions and thermal-hydraulic results presented in recent fusion reactor conceptual design studies are discussed. 16 references, 4 figures, 2 tables.

45740 **Three-dimensional cell calculations for a fusion reactor gas-cooled solid blanket.** Ragheb, M.M.H.; Maynard, C.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). *Atomkernenergie;* **32**: No. 3, 159-168(1978).

Neutronic cell calculations for a minimum lithium and tritium inventory solid gas-cooled fusion power plant blanket are investigated by three-dimensional Monte Carlo, and predict a substantial difficulty in attaining sufficient breeding, in contrast to previously published results. Actual three-dimensional configurations, heterogeneities, and material composition as imposed by mechanil, hydrodynamic, and heat transfer considerations, are accounted for. A gross blanket breeding ratio of 1.067 +- 0.026 is obtainable for the considered reference design. That value is thought inadequate if calculation and data uncertainties and reprocessing and system losses are acounted for. Our results update previous one-dimensional Discrete Ordinates results which predicted an overly optimistic gross blanket breeding ratio of 1.184 for the same design. These were based upon assumed preliminary material compositions and did not relastically model the configurations. For satisfactory breeding in such designs, stainless steel need be replaced by an alternative structural material for a better neutron economy in a predominantly saft spectrum. Three-dimensional cell studies seem necessary for reliable estimates of parameters in such basically heterogeneous systems.

MAGNET COILS AND FIELDS

45741 (UCRL—13990) **Assessment of stability characteristics of MFTF coils.** (General Atomic Co., San Diego, CA (USA)). Mar 1979. Contract W-7405-ENG-48. 13p. (GAC—15357). Dep. NTIS, PC A02/MF A01.

Certain aspects of the MFTF (Mirror Fusion Test Facility) conductor performance were investigated. Recovery analysis of the MFTF conductor was studied using GA's stability code. The maximum length of uncooled, unsoldered composite core which can recover from a thermal excursion was determined analytically. A maximum credible mechanical disturbance in terms of energy deposition, conductor motion and length, and time duration, was postulated. 5 references, 4 figures.

45742 **Induction of force-free currents by boundary displacements in a screw pinch.** Lui, H.C. (Columbia Univ., New York (USA). Plasma Physics Lab.). *Nucl. Fusion;* **19**: No. 2, 179-186(1979).

The plasma column in a screw pinch in equilibrium will expand or shrink with further heating or cooling. The force-free currents surrounding it will grow or decay as a result. A theory suitable for this problem is presented to describe the time evolution of these force-free currents. Both analytical and numerical solutions are presented for representative cases to demonstrate this induction effect.

45743 **Minimum-average-B wells in linked magnetic mirror fields.** Riordan, J.C. (General Atomic Co., San Diego, CA (USA)); Lichtenberg, A.J.; Lieberman, M.A. (California Univ., Berkeley (USA). Electronics Research Lab.). *Nucl. Fusion;* **19**: No. 1, 21-31(1979).

Minimum-average-B wells are examined for use in hydromagnetically stable linked mirror traps. A multipole expansion to fourth order in radius is used. The magnetic field shapes are chosen by a combination of heuristic and variational techniques to optimize the well radius. Numerical results show that the optimized wells are more practical than was previously realized, and that the required field shapes can be achieved with a simple coil configuration.

HEATING AND FUELING SYSTEMS

45744 (CONF-790602—50) **Economics of fusion driven symbiotic energy systems.** Renier, J.P.; Hoffman, T.J. (Oak Ridge National Lab., TN (USA); Lowell Univ., MA (USA)). 1979. Contract W-7404-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The economic analysis of symbiotic energy systems in which U233 (to fuel advanced converters burning U233 fuel) is generated in blankets surrounding fusioning D-T plasma's depends on factors such as the plasma performance parameters, ore costs, and the relative costs of Fusion Breeders (CTR) to Advanced Fission Converters. The analysis also depends on detailed information such as initial, final makeup fuel requirements, fuel isotopics, reprocessing and fabrication costs, reprocessing losses (1%) and delays (2 years), the cost of money, and the effect of the underutilization of the factory thermal installation at the beginning of cycle. In this paper we present the results of calculations of overall fuel cycle and power costs, ore requirements, proliferation resistance and possibilities for grid expansion, based on detailed mass and energy flow diagrams and standard US INFCE cost data and introduction constraints, for realistic symbiotic scenarios involving CTR's (used as drivers) and denatured CANDU's (used as U233 burners). We compare the results with those obtained for other strategies involving heterogeneous LMFBR's which burn Pu to produce U233 for U233-burners such as the advanced CANDU converters (MEU233-CANDU).

45745 (LBL—8769) **ARC snubbers for neutral beam sources.** Baker, W.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 8p. (CONF-790149—1). Dep. NTIS, PC A02/MF A01.

From Neutral beam power system workshop; Berkeley, CA, USA (17 Jan 1979).

It has been observed at LBL and verified many times that the amount of 1/2 CV^2 energy associated with the accel grid that a neutral beam source can tolerate under sparkdown conditions is quite limited. If this energy exceeds 5-7 Joules, serious degradation of the voltage holding capability of the source occurs. When the LBL 10 x 40 cm source was upgraded from 20 to 40 kV, even the lowest capacitance power supplies devised were only marginally acceptable. Some voltage holding difficulty occurred at the higher voltages as expected. A solution for this problem was devised using a stack of transformer cores near the source and routing all the power supply leads through them. This core stack snubber is apparently essential to the operation of the present sources at 120 kV.

45746 (WFPS-TME—79-016) **Resonance self-shielding in the blanket of a hybrid reactor.** Nir, I. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Mar 1979. Contract EG-77-C-02-4231. 52p. Dep. NTIS, PC A04/MF A01.

Three sets of energy group cross sections were obtained using various approximations for resonance self shielding. The three models used in obtaining the cross sections were: (a) infinitely dilute model, (b) homogeneous-medium resonance self shielding, and (c)

heterogeneous-medium resonance self shielding. The effects on the blanket performance of fusion—fission hybrid reactors, and in particular, on the performance of the current reference Westinghouse Demonstration Tokamak Hybrid Reactor blanket, were compared and analyzed for a variety of fuel-coolant combinations. It has been concluded that (1) the infinitely dilute cross sections can be used to produce preliminary crude estimates for beginning-of-life (BOL) only, (2) the resonance absorber finite dilution should be considered for BOL, poorly moderated blankets and well moderated blankets with low fissile material content situations, and (3) the spacial details should be considered in high fissile content, well moderated blanket situations.

45747 (WFPS-TME—79-017) **Dancoff factors evaluation for spheres.** Nir, I. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Mar 1979. Contract EG-77-C-02-4231. 38p. Dep. NTIS, PC A03/MF A01.

The possible use of fuel in the shape of spheres, in a fusion—fission hybrid reactor blanket due to the prospect of an improved refueling mechanism and irradiation uniformity as compared to a blanket composed of fuel rods, requires the development of new methods and computational capabilities for the related neutronic calculations. In this paper, the evaluation of Dancoff factors for a collection of spheres is studied, first for two identical spheres and then for an infinite lattice of identical spheres. The chord distribution function for two identical spheres is presented, from which the Dancoff factors are calculated. To further simplify the resonance calculations, simple and accurate approximations for the Dancoff factors of two spheres are evaluated. The many spheres system is analyzed using approximation methods, due to uncertainties concerning its geometrical arrangement. A close packed lattice of spheres is assumed and the corresponding Dancoff factors are estimated utilizing the two spheres results and integral properties of the spheres lattice. The estimated maximum error is no more than a few percent.

45748 Use of predissociation to enhance the atomic hydrogen ion fraction in ion sources. Kim, J. (to Dept. of Energy). US Patent 4,135,093. 16 Jan 1979. Filed date 24 Jan 1978. 6p.

PAT-APPL-871,880.

A duopigatron ion source is modified by replacing the normal oxide-coated wire filament cathode of the ion source with a hot tungsten oven through which hydrogen gas is fed into the arc chamber. The hydrogen gas is predissociated in the hot oven prior to the arc discharge, and the recombination rate is minimized by hot walls inside of the arc chamber. With the use of the above modifications, the atomic H_1 + ion fraction output can be increased from the normal 50% to greater than 70% with a corresponding decrease in the H_2 + and H_3 + molecular ion fraction outputs from the ion source.

45749 ICRF fuelling of tandem mirror end plugs. Kesner, J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). *Nucl. Fusion;* **19**: No. 1, 108-112(1979).

Generation of waves at the ion cyclotron frequency and its harmonics (ICRF) may be useful for fuelling as well as heating the high-energy and high-density mirror end plugs required by a tandem mirror. Fuelling may be accomplished by trapping the ions that are ejected from the central-cell electrostatic well as they flow out through the end plugs. It is shown that for a reasonable level of RF power this trapping can be quite efficient. Furthermore, for a fixed RF power level the trapping efficiency is seen to be adjustable by tuning the wave frequency.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 44415, 45221

45750 (LA-UR—79-1408) **Design of HELIOS beam diagnostics.** Seagrave, J.D.; Bigio, I.J.; Jackson, S.V.; Laird, A.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 17p. (CONF-790529—3). Dep. NTIS, PC A02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

Verification of satisfactory operation of the HELIOS eight-beam laser system requires measurement of many parameters of each beam on each shot. Fifty-joule samples of each of the eight 1250-J, subnanosecond 34-cm-diameter beams of the HELIOS system are diverted to a gallery of eight folded telescopes and beamsplit to provide diagnostic measurements. Total pulse energy, and prepulse and postlase energy of each beam are measured; pulse shape details and a wavelength spectrum of a selected beam from each shot are measured; and provision is made for retropulse measurement and optical quality monitoring. All data are recorded digitally in a local screen room, with control and communication through a fiberoptic link to the main HELIOS computer.

45751 Exploding pusher performance - A theoretical model. Rosen, M.D.; Nuckolls, J.H. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Fluids;* **22**: No. 7, 1393-1396(Jul 1979).

A simple model of "exploding-pusher" laser fusion targets is presented. The peak ion temperature is calculated by assuming that the ion heating mechanism is a shock followed by isentropic compression. The compression is calculated by conservation of mass and reasonable assumptions on the density profile at peak compression time. The neutron yield predictions of this model agree over a broad range of parameter space with those of complex one-dimensional numerical simulation, which in two dimensions have tracked experimentally measured yields quite accurately.

45752 Achromatic illumination system for small targets. Sigler, R.D. (to Dept. of Energy). US Patent 4,136,926. 30 Jan 1979. Filed date 14 Apr 1978. 6p.

PAT-APPL-896,540.

A pair of light beams is directed to provide illumination that is substantially uniform from all directions on a small target by a system comprising a pair of corrector windows, a pair of planar reflecting surfaces, a pair of paraboloidal mirrors and a reflecting mirror cavity. The components are arranged so that each of the beams passes through a corrector and is reflected from the planar surface to the paraboloidal mirror, from which it is focused through a hole in the planar surface to the interior of the cavity. The surface of the interior portion of the cavity is shaped to reflect the focused beam three times before the focused reflected beam strikes the target.

45753 Laser-driven isentropic hollow-shell implosions: the problem of ignition. Kidder, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nucl. Fusion;* **19**: No. 2, 223-234(1979).

It is shown that a relatively weak initial shock introduced into an otherwise isentropic hollow-shell implosion can cause central fuel ignition, the bulk of the fuel undergoing little increase in entropy. The imploded-state fuel configuration is analysed at the threshold of ignition, and it is found that electron heat conduction is the predominant cooling mechanism opposing fuel ignition. Approximate temperature-dependent rhoR requirements are presented for the conduction-limited ignition of thin DT shells, and for the equality of electron heat conduction and α-particle transport in thermonuclear burn propagation.

45754 Overview of design space for small fusion targets. Kirkpatrick, R.C. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Fusion;* **19**: No. 1, 69-79(1979).

A twelve-parameter burn code has been used to gain an overview of the design space available for laser and E-beam fusion targets. The results of a few thousand implosion calculations are presented here in terms of an initial-condition space. The initial conditions include temperature, density and pusher jump-off velocity. For marginal driving energy there is an isolated region in the initial-condition space (thetasub(o),rhosub(o)) for which ignition may be achieved.

45755 Manipulator for rotating and examining small spheres. Weinstein, B.W.; Willenborg, D.L. (to Dept. of Energy). US Patent Application 906,815. 17 May 1978. 11p.

A manipulator is described which provides fast, accurate rotational positioning of a small sphere, such as an inertial confinement fusion target, which allows inspecting of the entire surface of the sphere. The sphere is held between two flat, flexible tips which move equal amounts in opposite directions. This provides rolling of the ball about two orthogonal axes without any overall translation. The manipulator may be controlled, for example, by an x- and y- axis driven controlled by a mini-computer which can be programmed to generate any desired scan pattern.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 45716, 45738

45756 (CONF-790657—3) **Swelling, mechanical properties, and microstructure of Type 316 stainless steel at fusion reactor damage levels.** Horak, J.A.; Bloom, E.E.; Grossbeck, M.L.; Maziasz, P.J.; Stiegler, J.O.; Wiffen, F.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From Conference on irradiation behavior of metallic materials for fast reactor core components; Corsica, France (5 Jun 1979).

Alloys such as AISI 316 stainless steel exhibit more swelling and larger decreases in ductility when irradiated to produce fusion reactor He and dpa levels than at fast reactor He and dpa levels. For T ~ < 0.5 T/sub m/ swelling is decreased and ducility increased by cold work and/or small additions of Ti. Structural components of fusion reactors may have to operate below 550°C to ensure adequate ductility for long-term service.

45757 (COO—4184-6(Vol.1)) **Developing maintainability for tokamak fusion power systems. Phase II report. Volume I: executive summary.** Fuller, G.M.; Zahn, H.S.; Mantz, H.C.; Kaletta, G.R.; Waganer, L.M.; Carosella, L.A.; Conlee, J.L. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). Nov 1978. Contract EG-77-C-02-4184. 49p. Dep. NTIS, PC A03/MF A01.

The purpose of this report is to identify design features of fusion power reactors which contribute to the achievement of high levels of maintainability. Volume I, the Executive Summary, presents the progress achieved toward this objective in this phase and includes a comparison with the results of the first phase study efforts. A series of maintainability design guidelines and an improved maintenance system are defined as initial steps in developing the requirements for a maintainable tokamak fusion power system. The principle comparative studies that are summarized include the determination of the benefits of various vacuum wall arrangements, the effect of unscheduled and scheduled maintenance of the first wall/blanket, some initial investigation of maintenance required for subsystems other than the first wall/blanket, and the impact of maintenance equipment failures. (SPH)

45758 (COO—4184-6(Vol.2)) **Developing maintainability for tokamak fusion power systems. Phase II report. Volume II: study results.** Fuller, G.M.; Zahn, H.S.; Mantz, H.C.; Kaletta, G.R.; Waganer, L.M.; Carosella, L.A.; Conlee, J.L. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). Nov 1978. Contract EG-77-C-02-4184. 386p. Dep. NTIS, PC A17/MF A01.

In this second phase the impact of unscheduled maintenance, several vacuum wall arrangements, and maintenance of other reactor interfacing subsystems and maintenance equipment are added to the evaluation of the maintainability of the fusion power reactor concepts. Four concepts are normalized to common performance parameters and evaluated for their capability to achieve availability and cost of electricity goals considering both scheduled and unscheduled maintenance. The results of this evaluation are used to generate a series of maintainability design guidelines and to select the more desirable features and design options which are used to configure a preliminary reactor concept having improved maintainability. (SPH)

45759 (COO—4184-6(Vol.3)) **Developing maintainability for tokamak fusion power systems. Phase II report. Volume III: appendices.** Fuller, G.M.; Zahn, H.S.; Mantz, H.C.; Kaletta, G.R.; Waganer, L.M.; Carosella, L.A.; Conlee, J.L. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). Nov 1978. Contract EG-77-C-02-4184. 114p. Dep. NTIS, PC A06/MF A01.

This volume contains time estimate summaries to the second level of detail for scheduled or unscheduled maintenance of the first wall/blanket, some selected subsystem components and maintenance equipment. Elaboration of selected maintenance equipment functions and performance as well as conceptual designs is also included. (SPH)

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 44878, 45426

45760 (PB—284994) **Energy glossary.** (Minnesota Legislature Science and Technology Project, St. Paul (USA)). 12 Aug 1977. 23p. NTIS PC A02/MF A01.

This glossary has been prepared in conjunction with the 'Energy in Minnesota' Workshop. The workshop was held in response to legislator's needs for information on a spectrum of energy related issues. The definitions which are provided here are terms frequently used in discussing energy issues. The glossary has been divided into two parts. The first section includes general terms related to energy. The second section includes only nuclear terms. This separation has been made because of the large amount of specialized terminology in nuclear technology. The sources from which all the terms are excerpted are listed at the end of the glossary. Additional definitions and information may be found in these references.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 44410, 44882, 45540

45761 (CONF-790146—3) **Cost accounting an RJE station SAS.** Strand, R.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From 4. annual SAS User's group conference; Clearwater Beach, FL, USA (28 Jan 1979).

Remote Job Entry (RJE) station statistics are used in determining workloads and distributing cost of the facilities to departments. Summaries are generated to display the number of users, types of jobs processed through the RJE facility, and the persons (or projects) utilizing the facility. Selected summaries by user name, job name initials, and types of jobs run are presented in tabular form. 6 tables.

45762 (CONF-790459—5) **Nonlinear constrained optimization methods.** Minkoff, M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From Instrument Society of America, Pittsburgh modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1979).

Constrained nonlinear optimization problems often arise in modeling when it is desired to optimize some performance criteria subject to conditions which describe the operation of a system. In energy modeling such problems are often quite complex and may require an understanding of the nonlinear programing method used so as to exploit the structure of the specific problem. Some current directions in constrained nonlinear programing algorithm development are surveyed.

45763 (LA—7499-M(Vol.2)) **LTSS primer. Volume 2.** (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 48p. Dep. NTIS, PC A03/MF A01.

This primer is designed to acquaint users with how to run FTN programs on LTSS. While LTSS is an extremely elaborate system, the information supplied in this document is sufficient to allow users to compile, load, and execute uncomplicated FTN programs. The basic concepts appear first, and the more complicated information appears near the end of the document. The first five chapters describe how to become an LTSS user and sign on to the system from a terminal; how to create a Fortran program; and how to compile, load, and execute a program. Later chapters discuss how to obtain printer or microfiche output and how to access and use the permanent-file storage system called Hydra; special terminal keys that are used to obtain current information about the system; several system programs called utility routines that perform file handling tasks; how to prepare a Fortran program that was originally created on NOS, CROS, or some LTSS subsystem; and signing off.

45764 (LA—7752-MS) **Interactive use of computer drawn faces to study multidimensional data.** Bruckner, L.A.; Mills, C.F. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 30p. Dep. NTIS, PC A03/MF A01.

The interactive use of computer-drawn faces to examine multidimensional data is demonstrated. The code, DRFACE, allows the user to view facial representations of data at a graphics terminal and then, by easily made changes, to display new representations of the same data. The user can change the facial feature/data variable assignments, the facial feature ranges, and default values. This ability permits the user to determine if observations made about the data from viewing the first set of faces are due to chance assignments or actually reflect patterns in the data. 8 figures, 5 tables.

45765 (LA—7840-MS) **High-speed graphics terminal interface for a PDP-11 minicomputer.** Spencer, A.E. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

With the recent advances in storage tube technology, it has finally become economically feasible to provide high-quality graphics on a distributed rather than a local basis. The cost of graphics terminals has dropped dramatically from as much as $80,000 in 1967 to as little as $4000 today, allowing the proliferation of graphics terminals in much the same way as time-sharing (alphanumeric) terminals. A major hindrance in this process has been the problem of providing sufficient bandwidth to make most effective use of high-speed graphics, while retaining the serial, asynchronous communication desired for remote access. This paper describes the Asynchronous Line Interface developed by the Los Alamos Scientific Laboratory, which provides a means of high-speed, asynchronous communications (up to 150 kilobits per second) with 4010 series Tektronix graphics display terminals.

45766 (LBL—8278) **Long term file migration, Part II: file replacement algorithms.** Smith, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1978. Contract W-7405-ENG-48. 37p. NTISMFA01. Portions of document are illegible.

The steady increase in the power and complexity of modern computer systems has encouraged the implementation of automatic file migration systems, which move files dynamically between mass storage devices and disk in response to user reference patterns. From information describing thirteen months of text editor data set file

references (analyzed in detail in the first part of this paper), algorithms for the selection of files to be moved from disk to mass storage are developed and evaluated. Algorithms based on both the file size and the time since the file was last used work well. The best realizable algorithms tested condition on the empirical distribution of the times between file references. Acceptable results are also obtained by selecting for replacement that file whose size times time to last reference is maximal. Comparisons are made with a number of standard algorithms developed for paging, such as Working Set, VMIN, etc. Sufficient information (parameter values, fitted equations) is provided that the algorithms may be easily implemented on other systems. 15 figures, 4 tables.

45767 (SAND—78-1846) **Model for distributed service systems.** Strip, D.R. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 30p. Dep. NTIS, PC A03/MF A01.

Examples of distributed service systems range from computing networks to medical care delivery to trash recycling. Past efforts towards design optimization have been restricted to specialized aspects of computer networks. The distributed service model presented here addresses the problem with a generality and accuracy far greater than existing models. Some general optimization results are summarized.

45768 (UCID—18038) **Advanced digital computing technology base development for Navy applications: S-1 Project FY78 final report. Executive summary.** McWilliams, T.M.; Widdoes, L.C. Jr.; Wood, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1978. Contract W-7405-ENG-48. 1307p. Dep. NTIS, PC A99/MF A01.

The fundamental objectives of the S-1 Project's work are to enable the Navy to be able to evaluate at any time, quickly, reliably, and inexpensively, what is available from the then-current state of the art in digital processing systems and what the relevance of such systems may be to Navy data processing applications, and to provide reference prototype systems to support possible competitive procurement action leading to deployment of such systems. The type of digital data processing system on which the S-1 Project has focused its attention is essentially unrepresented in commercial computer systems. It is basically a hybrid of an advanced programable signal processor and a general-purpose, high-performance scientific computer system, which, moreover, emphasizes system reliability and maintainability to extents almost unparalleled in commercial computer offerings. The primary means chosen by the S-1 Project to be able to design and implement its processor systems in maximally current technology was the creation of the S-1 Structured Computer-Aided Logic Design (SCALD) System, a powerful aid for the computer system architect/designer which substitutes for essentially all the junior engineer/draftsman-level effort ordinarily required to support such work. Use of the SCALD System leaves the system architect free to specify the design on a relatively abstract, highly conceptual level. The software development task was greatly facilitated by several features which permit high-level language programs to make unusually efficient use of hardware resources. The S-1 multiprocessor is described first; this is followed by a discussion of the single S-1 processors used to constitute such a multiprocessor system, and a description of the SCALD System. The remainder of the report consists of a series of articles of various other aspects of the work of the Project. (RWR)

45769 (UCID—18196) **Eclipse users manual.** Ames, H.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1979. Contract W-7405-ENG-48. 41p. Dep. NTIS, PC A03/MF A01.

The Eclipse minicomputer at LLL is being used for the automation of analytical instruments, sample documentation, system programing, BASIC programing, and other purposes. This document defines the rules, procedures, and resources to be used for software development on the Eclipse. It is divided as follows: hardware configuration, software configuration of disk storage media, operating procedures (bringing up the system, running BASIC, using the system disk, back-up procedures, recovery procedures, using other resources, reporting problems), operating system and system utilities, BASIC, FORTRAN IV, FORTRAN V, COBOL, and ALGOL. 10 figures, 2 tables. (HWR)

45770 (UCRL—81987) **Interactive documentation system.** Beatty, J.C.; Chin, J.S.; Moll, H.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Apr 1979. Contract W-7405-ENG-48. 14p. (CONF-790806—2). Dep. NTIS, PC A02/MF A01.

From SIGGRAPH '79; Chicago, IL, USA (6 Aug 1979).

Most chronic users of time-sharing computer systems are familiar with programs that allow the creation and manipulation of text files. Less often they have at their disposal programs that will format the document described by a text file, generating output such as a typist might produce. Rarely is there any mechanism by which graphics can be integrated with text. Lawrence Livermore Laboratory has a powerful, flexible, and interactive computer-based documentation system that will format a source document description according to user specifications and incorporate illustration to produce on-line documents, offset reproduction masters, 35-mm color slides, movie titles, or viewgraphs. The flexibility of the system is greatly enhanced by the use of a device-independent graphics library. Text may be plotted by using the hardware characters specific to a device (when possible), or may be drawn as Hershey characters or polygonally outlined symbols. Illustrations may be defined in a simple 2d graphics language, and graphical output from application programs may also be incorporated directly into a document. 5 figures.

45771 **Stochastic model of the Isle Royale biome.** Beyer, W.A.; Harris, D.R.; Ryan, R.J. *Rocky Mt. J. Math.;* 9: No. 1, 3-18(Jan 1979).

A stochastic model employing and event-consequence technique is developed for a three-species interaction. If the system is in some state x^1 at time t, the elapsed time to the next event is chosen by means of a Poisson distribution exp [-tauΣ/sub x/2g (x^1,x^2,t)]. The type of event (birth, death, predation, etc.) is then chosen from the distribution: g $(x^1,x^2,t)/\Sigma$/sub x/2g (x^1,x^2,t) where g is some nonnegative function. Thus the classical system of differential equations is replaced by a set of transition probabilities P/sub tt+δ/,$(x^1 \rightarrow x^2)$ <g (x^1,x^2,t) δt+0(δt). The set of states and transition probabilities incorporates the age structure of the three species (17 for the moose, 9 for the wolf, 1 for the plant). This discrete space-continuous time model is applied to the data from the Isle Royale National Park studies of Allen, Mech, etc. An estimate of the predictive ability of this simulation is made after considering the statistical uncertainty of the model and the model's goodness of fit.A code, called BIOTA1, exists in Fortran, which will process a general n-species stochastic model.

INFORMATION HANDLING

45772 (PB—284646) **National needs for critically evaluated physical and chemical data. (the 'codan' report). Final report.** Stockmayer, W.H. (National Research Council, Washington, DC (USA). Numerical Data Advisory Board). Jun 1978. Contract NSF-C310-TO-336. 78p. NTIS PC A05/MF A01.

The report assesses the level of critical evaluation of numerical data needed to meet national needs for reliable scientific data, and the funding needed therefor. The report (1) surveys the organizations that currently carry out critical data evaluation and determines the present level of funding for such activities; (2) studies the role of organized data collections and the required depth of evaluation of the data in previous RandD programs and assesses the benefits of such activities relative to their cost; (3) identifies current and future data needs in major national RandD programs, particularly those concerned with energy, environmental quality, and materials utilization. The report, concluding that the present level of data evaluation activities is about 1/3 to 1/2 that needed, makes several recommendations for administrative methods of action to help correct this situation.

45773 (SAND—79-0014) **Style guide (mechanical) for technical writers.** Lopez, L.S. (comp.). (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 105p. Dep. NTIS, PC A06/MF A01.

The need for consistency and for a centralized guide in which certain mechanical aspects of style can be readily found led to this manual. Because style is a highly personal skill that depends as much on ear as it does on correct usage of grammar, only the really troublesome aspects of grammar are discussed.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Aerospace Corp., El Segundo, CA (USA)
10 MW solar thermal pilot plant dynamic simulation. Volume I. Computer program description, 4:44549 (ATR—78(7747)-1(Vol.1))
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Conceptual design study of a concrete canister spent-fuel storage facility, 4:44374 (AECL—6301)

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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(The group of all interactions of two particles producing a specific final state.)

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	4:45746	WFPS-TME—79-016
	4:45747	WFPS-TME—79-017
EG-77-C-02-4544	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.**	
	4:45737	WFPS-TME—107
EG-77-C-02-4557	**RCA Labs., Princeton, NJ (USA)**	
	4:44627	COO—4557-1
EG-77-C-03-1439	**Institute of Gas Technology, Chicago, IL (USA)**	
	4:44575	SAN—1439-8
EG-77-C-03-1590	**Carrier Corp., Syracuse, NY (USA). Energy Systems Div.**	
	4:44577	SAN—1590-1/1
EG-77-C-03-1605	**McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)**	
	4:44552	SAN—1605-7(Vol.1)
EG-77-G-03-1514	**Bickle (Larry W.) and Associates, Albuquerque, NM (USA)**	
	4:44576	SAN—1514-1
EG-77-S-02-4298	**Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering**	
	4:44467	COO—4298-1
EG-77-S-02-4546	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
	4:44614	COO—4546-13
	4:44653	COO—4546-2
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ER-78-S-02-4679	**Illinois Univ., Urbana (USA). Dept. of Ceramic Engineering**	
	4:44934	COO—4679-1
ER-78-S-05-6036	**Texas A and M Univ., College Station (USA). Cyclotron Inst.**	
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ET-78-C-03-2028	Aerospace Corp., El Segundo, CA (USA)	
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ET-78-S-01-3128	Tufts Univ., Medford, MA (USA). Dept. of Chemical Engineering	
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ET-78-S-02-4649	Iowa State Univ. of Science and Technology, Ames (USA)	
	4:45014	COO—4649-4
ET-78-S-02-4878	Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.	
	4:44551	COO—4878-3
EW-76-C-15-2395	Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.	
	4:44761	CONF-790615—13
EW-78-F-07-1768	CH2M Hill, Anchorage, AK (USA)	
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EW-78-S-09-1061	Clemson Univ., SC (USA). Dept. of Forestry	
	4:45430	DOE/SR/01061—1
EW-78-S-19-0008	Florida Univ., Gainesville (USA)	
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EX-76-A-01-2295	Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.	
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EX-76-A-29-1012	Jet Propulsion Lab., Pasadena, CA (USA)	
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EX-76-C-01-1726	Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.	
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EX-76-C-01-1743	Conoco Coal Development Co., Library, PA (USA). Research Div.	
	4:44224	FE—1743-62
EX-76-C-01-1760	Tennessee Univ., Tullahoma (USA). Space Inst.	
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EX-76-C-01-1793	Foster-Miller Associates, Inc., Waltham, MA (USA)	
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EX-76-C-01-2032	Catalysts and Chemicals, Inc., Louisville, KY (USA)	
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EX-76-C-01-2240	Braun (C.F.) and Co., Alhambra, CA (USA)	
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EX-76-C-01-2247	Texaco, Inc., Montebello, CA (USA). Montebello Research Lab.	
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EX-76-C-01-2297	Department of Energy, Washington, DC (USA). Div. of Coal Conversion	
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EX-76-C-01-2306	Suntech, Inc., Marcus Hook, PA (USA). Research and Engineering Div.	
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EX-76-C-01-2333	Institute on Man and Science, Rensselaerville, NY (USA). Dept. of Economic and Environmental Studies	
	4:44478	TID—29406
EX-76-C-01-2357	General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.	
	4:44709	FE—2357-13
EX-76-C-01-2361	Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)	
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EX-76-C-01-2416	Badger Plants, Inc., Cambridge, MA (USA)	
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EX-76-C-01-2445	Water Purification Associates, Cambridge, MA (USA)	
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	4:44870	DOE/TIC—10146
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EY-76-C-02-3000	Fermi National Accelerator Lab., Batavia, IL (USA)	
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EY-76-C-02-3069	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics	
	4:45633	COO—3069-674
EY-76-C-02-3071	Pennsylvania Univ., Philadelphia (USA). Dept. of Physics	
	4:45549	COO—3071-236
EY-76-C-02-3490	Rochester Univ., NY (USA). School of Medicine and Dentistry	
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EY-76-C-02-4094	Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.	
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EY-76-C-03-0063	California Inst. of Tech., Pasadena (USA)	
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EY-76-C-03-0115-131	SRI International, Menlo Park, CA (USA)	
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EY-76-C-03-0167-023	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-038	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-053	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-065	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0515	Stanford Linear Accelerator Center, CA (USA)	
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	4:44766	GEFR—10028-68
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EY-76-C-03-1011	**Agbabian Associates, El Segundo, CA (USA)**	
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EY-76-C-05-0033	**Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis**	
	4:44355	ORAU/IEA—79-8(R)
EY-76-C-05-1156	**National Lead Co. of Ohio, Cincinnati (USA)**	
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EY-76-C-06-1830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
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EY-76-C-11-0292	**Duquesne Light Co., Shippingport, PA (USA)**	
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EY-76-S-02-2458	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering**	
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EY-76-S-02-2854	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering**	
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EY-76-S-02-2858	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
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EY-76-S-02-2874	**SIAM Inst. for Mathematics and Society, Philadelphia, PA (USA)**	
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EY-76-S-02-3459	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering**	
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EY-76-S-02-4122	**Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering**	
	4:44803	CONF-790802—1
EY-76-S-05-3992	**Texas Univ., Austin (USA). Center for Particle Theory**	
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EY-76-S-05-5065	**West Virginia Univ., Morgantown (USA). Dept. of Geology**	
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EY-76-S-06-2225-005	Washington Univ., Seattle (USA). Dept. of Genetics	
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5	4:44841	Dep. NTIS, PC A02/MF A01
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4	4:44978	*See* LBL-8949
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1	4:45434	*See* LBL-8850
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3	4:45750	*See* LA-UR-79-1408
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5	4:45414	*See* UCRL-82653
CONF-790538-		(Fast ion transport in solids-electrode and electrolytes conference, Lake Geneva, WI, USA, 21-25 May 1979)
1	4:45143	*See* BNL-26075
11	4:45165	Dep. NTIS, PC A02/MF A01
CONF-790540-		(2. international conference on megagauss magnetic field generation and related topics, Washington, DC, USA, 29 May-1 Jun 1979)
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5	4:45303	*See* UCRL-81973
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3	4:44629	*See* SAND-79-1053C
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1	4:44818	*See* BNL-26197
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44	4:44763	*See* COO-2458-23
46	4:45215	*See* UCRL-82754
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2	4:45604	*See* SLAC-PUB-2334
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7772-MS	4:44882	Dep. NTIS, PC A03/MF A01
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7793-MS	4:44756	*See* NUREG/CR-0776
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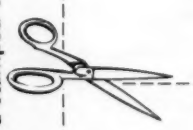

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